Metal Finishing

POLISHING AND BUFFING · BARREL FINISHING · CLEANING
PLATING · ANODIZING · RUST PROOFING · LACQUERING & ENAMELING

JULY, 1958

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Read and pass on—

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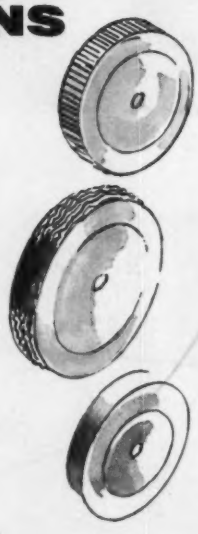
LIBRARY OF CLEPO SERVICE

NO TARNISH OR HAZE REMAINS



Are you buffing non-ferrous metals such as aluminum, brass or zinc-base die-castings? Any trouble 'cleaning' these surfaces of residual compound without leaving stains or haze?

Try CLEPO 90-J . . . an organic blend with exceptional detergent, emulsification and cleansing properties. Completely water soluble. Contains no organic solvents. No contamination of plating solutions.

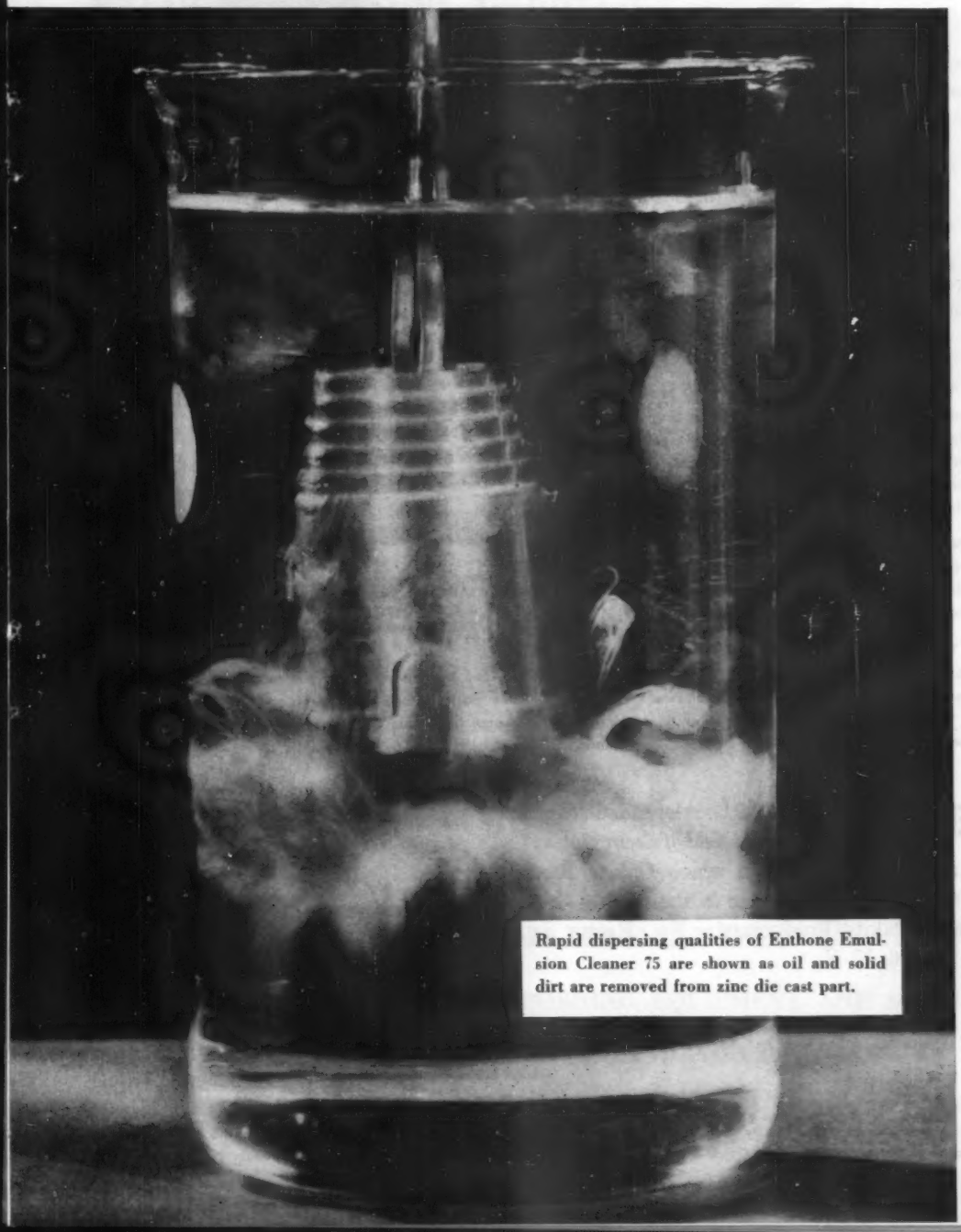
This formulation is completely free of alkalies and inorganic salts that tend to tarnish or etch the non-ferrous metals. Long on the market, CLEPO 90-J is being used in many shops as a regular step in their production schedule. We'll be glad to send you a sample for a good comparative laboratory test. Better yet why not order a sufficient quantity for a good production run?

The CLEPO Service Man in your territory will be glad to tell you more about CLEPO 90-J as well as the many other CLEPO Formulations that serve your industry in the cleaning, stripping and etching field.

FREDERICK GUMM *Chemical Company Inc.*

538 FOREST STREET, KEARNY, N. J.

How to make metal cleaning an exact science: Enthone's broad range of cleaning and degreasing compounds are the end result of more than 20 years of applied research in the laboratory and in the field on metal finishing problems. These compounds include emulsifiable and solvent cleaners, alkaline cleaners for soak or electrolytic cleaning of iron, steel, copper, brass, zinc and zinc base die castings. And if there's no Enthone stock cleaner that meets your requirements, Enthone will develop a special one that does. Write us about it. Enthone, Inc., 442 Elm St., New Haven 11, Conn.

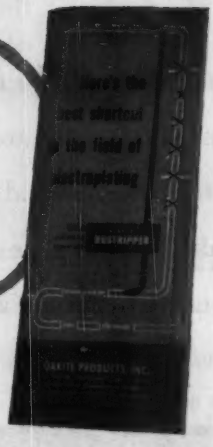


Rapid dispersing qualities of Enthone Emulsion Cleaner 75 are shown as oil and solid dirt are removed from zinc die cast part.

ENTHONE

ENTHONE, INC. IS A SUBSIDIARY OF AMERICAN SMELTING AND REFINING COMPANY

Platers find many uses for chelating *cleaner



*Chelating (pronounced key-lating) cleaners convert metallic salts and oxides into compounds soluble in water.

By chelating and removing rust or heat scale at the same time that it removes oil, Oakite Rustripper combines pickling and alkaline cleaning into one operation. It also avoids disadvantages of acid pickling, such as hydrogen embrittlement and etching of machined surfaces.

Platers now use Rustripper for dozens of difficult steel-cleaning jobs. Here are some examples reported in recent weeks:

CALIFORNIA: "Rustripper has ended pickling damage such as embrittlement." (Removing oil and light rust from machined landing gears before cadmium plating.)

NEW YORK: "Now saving about $10.40 per day on removing rust and scale and producing brighter plate." (Rustripper, added to reverse current cleaner in automatic plating machine, has eliminated separate pickling of wire towel racks before nickel and chrome plating.)

CONNECTICUT: "Rustripper added to reverse current cleaner has eliminated troublesome smut from metal furniture prior to copper-nickel-chrome plating."

NEW YORK: "Rustripper very good in barrels for derusting and brightening business machine parts . . . also for removing brown stains from parts put through black oxide treatment."

NEW YORK: "Small steel aircraft parts were embrittled by acid pickling. Rust, heat scale and stains are now safely removed by Rustripper and cyanide."

NEW JERSEY: "Only two cleaning rejects in first 15,000 parts plated." (After Rustripper was added to reverse current cleaner in automatic plater to eliminate smut from tubular steel furniture.)

INDIANA: "Rustripper is the best barrel compound we ever used for this job." (Removing tough heat treat scale from steel screws.) "Total cleaning and zinc plating time has been cut in half."

NEW YORK: "Had trouble with light rust on business machine parts before cadmium plating; also with smut left after electrocleaning. Rustripper cured both troubles."

FREE A 14-page illustrated booklet called *"Here's the best shortcut in the field of electroplating"* tells about many ways in which Oakite Rustripper can be of great value in the plating shop. Write to Oakite Products, Inc., Rector St., New York 6, N. Y.

OAKITE

SCIENCE

Technical Service Representatives in Principal Cities of U.S. and Canada
Export Division Cable Address: Oakite

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For 59 Years ...L'HOMMEDIEU...

year after year has manufactured Reliance Plating, Polishing Equipment, Supplies for Better and More Profitable Metal Finishing

RELIANCE PLATING BARRELS

Easy to Handle . . . Save Time and Money
Uniform Current Distribution
Plating Begins at Once

* * *

Lucite — Hard Rubber or Bakelite Cylinders
Motor — Geared in Head
Minimum Maintenance

* * *

Write for Reliance Plating Barrel Specifications

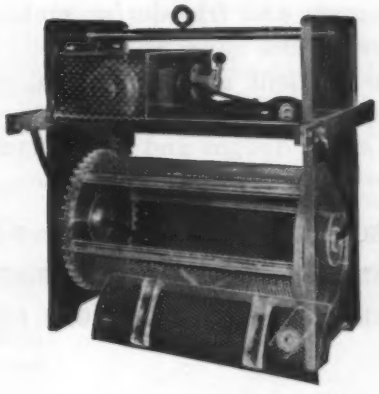
RELIANCE SELENIUM RECTIFIERS

Designed for all metal finishing operations.

High power factor and low ripple.

6 to 48 volts D.C.

Basic-self-contained or with Remote Control.



RELIANCE LUCITE

Portable Plating Barrel

Built of extra heavy High Temperature Lucite for volume production and stability.

Cylinder: 10"x18" inside. Equipped with Reversing Switch to permit stopping and securing barrel for loading and/or unloading.

Chas. F. L'Hommedieu & Sons Co.

MANUFACTURERS OF METAL FINISHING EQUIPMENT AND SUPPLIES
GENERAL OFFICE AND FACTORY
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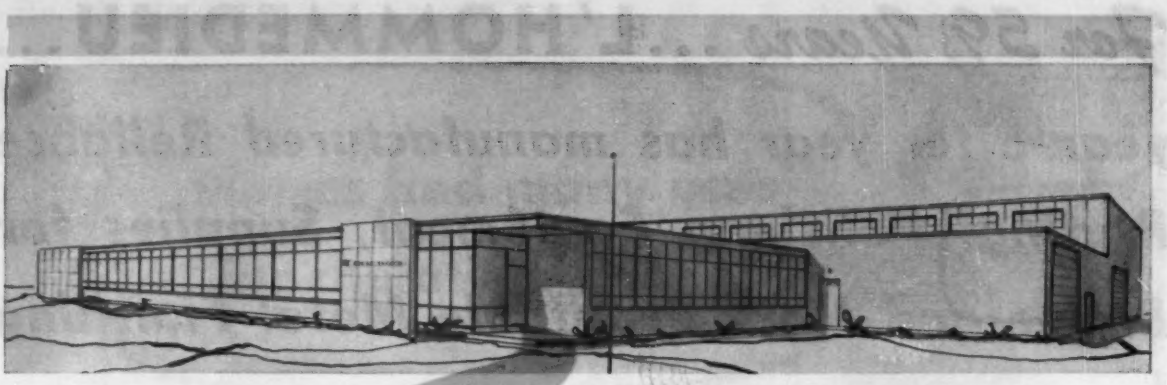


Crown Expands Again!

1914
Desplaines Street
Chicago, Ill.

1924
Maypole Avenue
Chicago, Ill.

1945
Kimball Avenue
Chicago, Ill.

1958
Centex Park
Elk Grove, Ill.

To keep pace with the continuing progress of the metal finishing industry, Crown Rheostat and Supply Company is again expanding its manufacturing facilities.

This is the fourth time since 1914 we have had to enlarge our plant to meet the increasing demand for Crown Equipment ... in June we will expand our capacity by 60% when we move into our new plant in Centex Park, Elk Grove, Illinois.

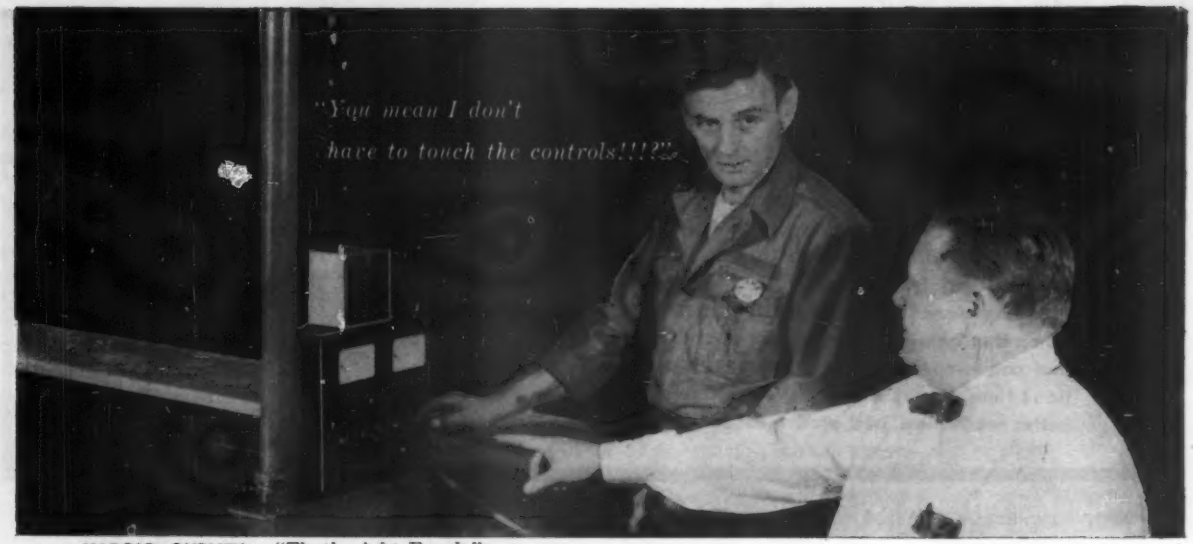
A sincere "thank you" to our many customers and friends for making this expansion and move necessary.

For efficient and economical plating, cleaning, anodizing and pickling processing Crown designs and manufactures the following equipment and supplies:

CROWN AUTOMATICS — **PLATING BARRELS**
CENTRIFUGAL DRYERS — **CROWN RECTIFIERS**
TUMBLING MACHINES — **CROWN RHEOSTATS**

CROWN

CROWN RHEOSTAT AND SUPPLY COMPANY
1965 Pratt Blvd., Elk Grove Village, Ill.



HAROLD GURNEY: "That's right Frank."
"*This* unit is specially designed for anodizing. With this new RAPID rectifier, output current adjusts itself automatically to compensate for load changes."

Plating Foreman: "You mean I set it once and forget it?"

Harold Gurney: "Right again. You see, the unit continuously senses load variations and automatically maintains a constant current density per square foot of work."

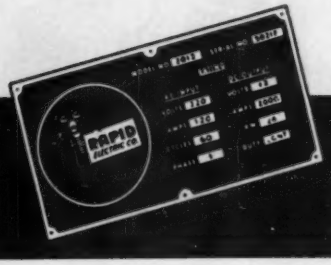
Plating Foreman: "That makes it a lot easier to accurately control a pre-determined film thickness in anodizing."

Harold Gurney: "You're catching on fast. And what's more, Automatic Current Density Control eliminates the possibility of overcurrent and subsequent costly rejects, maintaining Fenn's high quality standards."

Fenn Manufacturing Company, Newington, Connecticut

Take a tip from Harold Gurney. Find out how ACC can save you both time and money.

Write for Rectifier News Bulletin Vol. 2, No. 1 or ask to have a representative call. No obligation of course.



THE NAMEPLATE THAT MEANS *"More Power to You!"*

RAPID ELECTRIC COMPANY

12838 Fenkell Avenue • Detroit 27, Mich. • Diamond 1-8537

2881 Middletown Road • New York 61, N. Y. • TAlmadge 8-2200

Keeping profits on the boil:

CAN SOLVENTS MEET THE CHALLENGE?

Today's high standards in mass production metalworking have made metal cleaning a vital arm of production. With final operations demanding more rigid specifications and with final check-out increasingly automated, parts and pieces rejected because of improper cleaning can tie up your metal cleaning assembly line. When that happens, costs go up, profits down. Are there solvents that can keep pace with today's high-speed, top-quality production? Here's news from Dow of an important trend that can mean better production, and profits, for the industry.

You may wish to check certain items in this advertisement and forward to those concerned in your own company.

Route to:

_____

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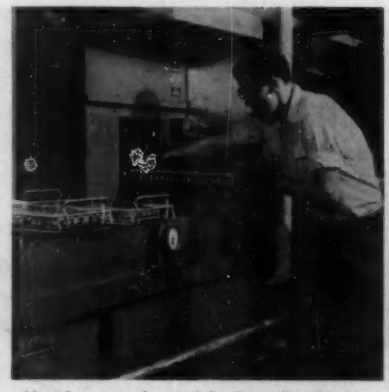
LIGHT METALS FABRICATOR SWITCHES TO PERCHLOROETHYLENE...

cuts rejects, speeds production

A major light metals fabricator recently solved an annoying cleaning problem in its production line . . . it switched to Perchloroethylene for degreasing. Result: cleaner parts first time through, rejects and reruns cut to a minimum.

Their chief engineer says: "We had not thought of Perchloroethylene as a solvent for our cleaning line setup but when we ran into cleaning trouble on the line, our lab ran tests of Per against other chlorinated solvents. We found that (particularly in the case of aluminum and other white metals) we got better, reject-free cleaning and faster production because of the longer condensation time. Now we've standardized on Per".

Nationwide switch to Per. A high-placed metals-cleaning theorist recently predicted: "The odds are high that a substantial part of production-line metal cleaning will be done with Perchloroethylene in the next three to five years". Nevertheless, right from the start Per has had to combat the false economy story that goes like this: "The additional heat needed for Perchloroethylene makes the degreasing operation costlier than using other standard chlorinated solvents". Actual on-the-job performance tests have shown that, in most instances, any additional heat cost is more than offset by the savings from better cleaning.

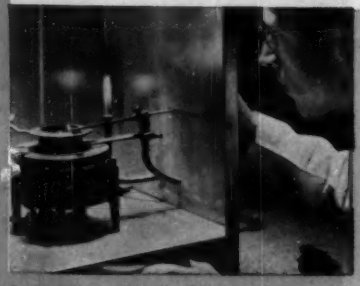


Metal parts cleaned in Dow Perchloroethylene vapors come out whistle clean.

Per wins Fahrenheit war. As metal-cleaning engineers know, the secret of Perchloroethylene's higher cleaning power is in its higher boiling point, for example, 250°F. as against 189°F. for trichloroethylene . . . a distinct advantage when removing entrapped moisture in porous metals, deeply recessed parts, and blind holes. Since water boils at 212°F., responsible metal cleaning men recognize the profit advantage of the higher boiling point solvent to insure moisture removal. Per's high-boil style is particularly helpful in the case of light gauge parts —by allowing longer, more thorough cleaning and rinsing action.

Although honor grades can be assigned tests of various vapor degreasing solvents, Per rates "A" in performance. As a quality performer it offers:

FOUR MORE DOW



CHLOROTHENE® . . .
Dow's new, safer solvent. No appreciable fire hazard. No flash or fire point. Today's hottest cold-cleaner for electrical equipment and machinery.

higher stability, reduced staining, lower solvents loss, higher solvency power, longer cleaning action, and the elimination of moisture. As an added bonus it comes highly recommended for aluminum cleaning. These customer benefits put Per at the head of the class.

When the vapor trails of competitive solvent claims confuse, most metal engineers consult with a company that makes many different kinds of solvents and can evaluate them all impartially. Dow, for example, will be glad to send a copy of its new 24-page brochure "Modern Vapor Degreasing".

*NEW "TRI" BY DOW
. . . helps missiles make clean getaway

Premature explosion of a rocket could be an expensive blast for everyone . . . especially the taxpayer. One of America's leading rocket builders hedged against its big birds going off half-cocked because of dirty missile hardware. A fast consultation with Dow revealed this urgent story . . .

Today's big rockets use liquid fuels that employ an oxidizer (such as liquid oxygen) to burn the fuel. The oxidizer and the fuel are kept in separate tanks and then piped into a combustion chamber where, on contact, they explode and burn. The missile trouble-shooters found that metal-cleaning materials used had left a residue, not inert to the oxidizer. Result: premature explosion. The problem: find the right material to clean the hardware.

Scientists at the Dow laboratory in Texas immediately began development of a new high purity Trichloroethylene for cleaning missile hardware. They conducted pioneer shock impact tests on many different solvents, and from the data developed, created HI-TRI* (high purity Trichloroethylene) to meet the most exacting requirements of the missile makers.

Dow also makes three other types of Trichloroethylene . . . neutral, alkaline, and extraction . . . for all sorts of down-to-earth uses.

*TRADEMARK OF THE DOW CHEMICAL COMPANY

*CAUSTIC SODA . . . Old workhorses never die

Along with new trends and techniques, a good deal of basic metal cleaning is still being done by alkali washing, using such chemical workhorses as Caustic Soda and Sodium Orthosilicate in cleaning formulations.

Most metal cleaning compounds made by experienced formulators are good. But even in these old-line products, there is a wide range of quality. You are assured of a top-quality product from the alkalinity standpoint if your formulator uses Dow Caustic Soda or Sodium Orthosilicate in his formulations.

Contact Dow for a list of modern formulators who use Dow Alkalies in their products.

★ ★ ★ ★

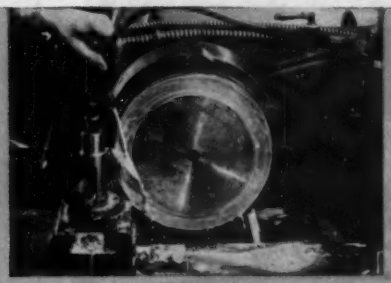
Dow makes many chemicals for many jobs in the metalworking industries. If you would like to know more about them, please write THE DOW CHEMICAL COMPANY, Midland, Michigan. Chemicals Sales Department 761F.

DOW CHEMICALS
basic to the metalworking industry

Chlorinated Solvents • Brominated Aliphatics • Alkalies
Ion Exchange Resins • Glycol Ethers • Preservatives
Hydrochloric Acid • Phenolsulfonic Acid • Ammonia
Industrial Glycols • Polyethylene Glycols • Polypropylene Glycols

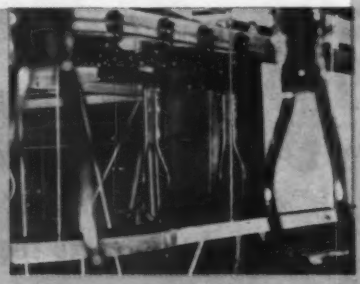
YOU CAN DEPEND ON DOW

CHEMICALS *for the metalworking industry*



DOWICIDE® A . . .
Ends machinery's "Monday morning odor". Used as a preservative in soluble cutting oil, no bad odor at the machine due to the build-up of bacteria and mold will develop over the weekend.

SODIUM ORTHOSILICATE . . .
Recently improved S.O.S. by Dow is "nearly anhydrous". Now many metal-cleaning formulations containing it cut through dirt and grease quicker and better than ever.



METHYLENE CHLORIDE . . .
Its boil-point is low, its temperature high. Whenever the alloy is special and the temperature can't be too high, Dow's M.C. is the solvent of choice in vapor degreasing.

pipe coils are old fashioned...

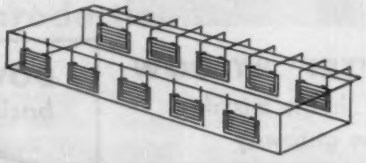
low installation and maintenance costs
greater heat transfer efficiency
lower space requirements

Write for free Bulletin P-52 "HOW TO CUT HEAT TRANSFER COSTS WITH PLATECOIL" for complete information.

KAWNEER uses stainless steel PLATECOIL® units in acid anodizing tanks

Ease of changing, cleaning and repair are among the advantages of PLATECOIL over pipe coils cited by the KAWNEER CO. Architectural Products Division at Niles, Michigan. Low installation costs, good maintenance and space savings over pipe coils plus heat transfer efficiency are advantages which this company has obtained by using PLATECOIL. The PLATECOIL units are used for heating in water seal, caustic and cleaner tanks; for cooling in anodize tanks.

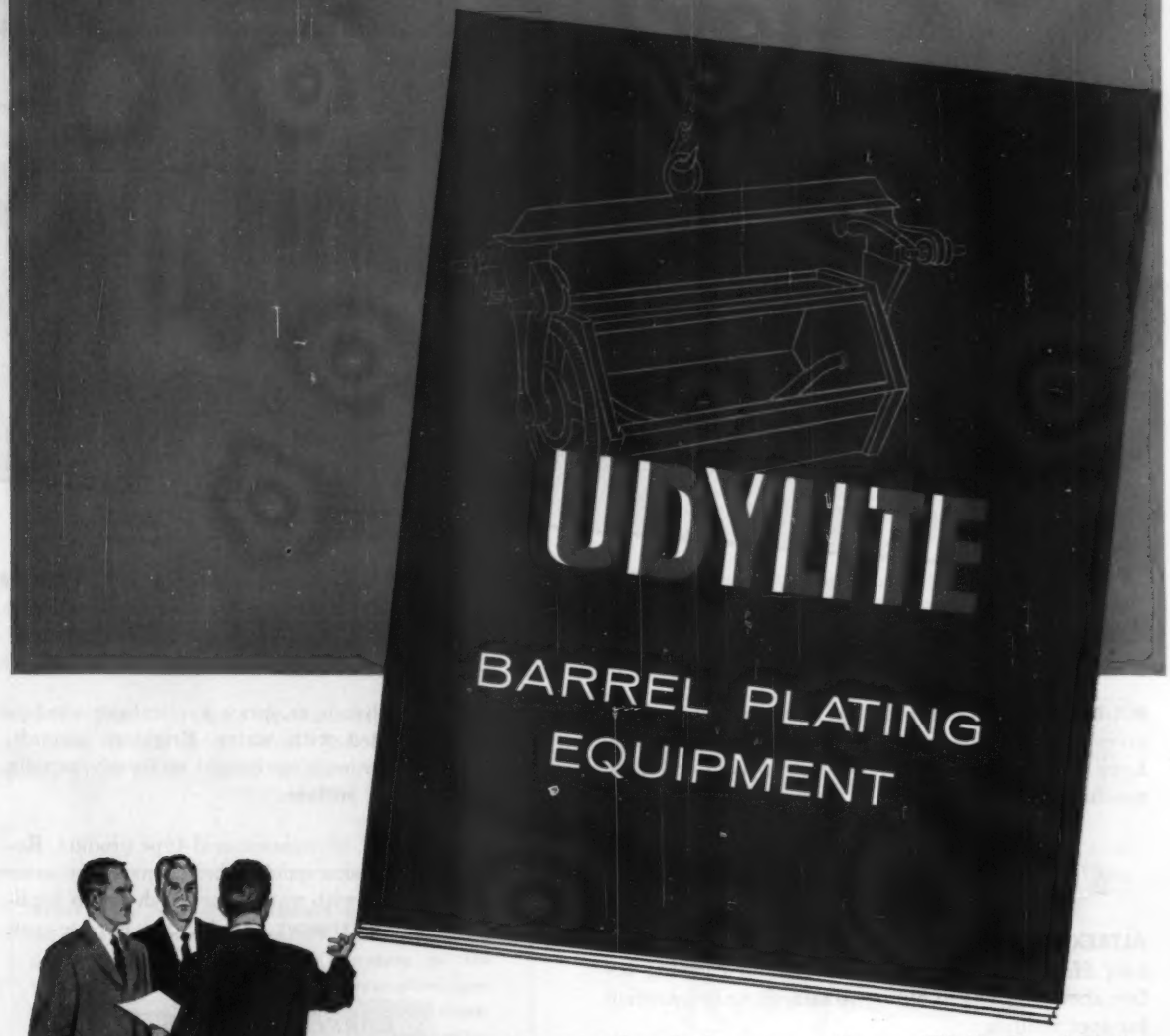
The drawing and photo show the location of the PLATECOIL units in an acid anodizing tank with PLATECOIL connections which can be broken above the surface of the solution for easy maintenance.



TRANTER MANUFACTURING INC.
LANSING 9, MICHIGAN

PLATECOIL®
DIVISION

NEW EQUIPMENT—NEW METHODS—NEW IDEAS
...for faster, more efficient plating!



JUST OFF THE PRESS and ready for you . . . the new Udylite Barrel Plating Bulletin! Whether you now have a barrel plating set-up . . . you are planning on installing one . . . or you just want to keep up with the latest methods of metal finishing, this bulletin provides invaluable ideas for a more profitable, productive plating operation. Loaded with pictures and specifications of up-to-date equipment, this book details what is needed for fast, accurate barrel plating . . . it even shows an ideal barrel plating layout and describes the necessary equipment. Also, it serves as a valuable checklist for keeping your plant well equipped. No modern minded plating shop should be without it. For a free copy contact your local Udylite representative today, or write direct to:

the udylite corporation

detroit 11, michigan • world's largest plating supplier

Look to Wyandotte for the

ETCHING

MIL-ETCH — Etches rapidly at low concentrations; gives uniform, fine-grained etch. No scale or sludge. Long life, simple control, no excessive foam or fumes, nondusty to handle.

CLEANING

ALTREX* — Nonetching, heavy-duty soak cleaner with long life, high detergency. Excellent for cleaning before anodizing, chemical film treatment, or preparation for spot welding.

SPRAY-ALTREX — Spray cleans without etching, has new low-foaming detergents. Easy to control, it works well in all kinds of water.

WYANDOTTE 468 — Neutral, solvent-type cleaner. Miscible with either hydrocarbon solvents or water. Removes oil, buffing compounds, drawing compounds without etching.

DESMUTTING

WYANDOTTE 2487 — Brightens aluminum alloys that darken in alkaline etching processes. Safer than acids; permits close control of desmutting bath. Easy-to-handle granular form; makes solutions of long life.

BRIGHTENING

I-2767-C — For brush or spray application; used as received or diluted with water. Brightens aircraft, truck trailers, aluminum equipment uniformly, rapidly without corroding surface.

PHOS-IT* — Liquid, phosphoric-acid-type product. Removes heavy corrosion quickly, brightens at the same time. Used diluted with water. For brush or dip application. Has high detergency, rapid action, low use-cost.

BARREL FINISHING

ALTREX — For deburring and radiusing with stones or chips. Offers excellent cutting qualities and economy.

BURNEK* 22 — For ball burnishing. Provides real economy for short and medium runs.

DEOXIDIZING

WYANDOTTE 2487 — Provides excellent preparation for spot welding. Gives uniformly low contact resistance on practically all alloys. No heat or close temperature control necessary. No appreciable surface etching. Work can be stored up to 96 hours before welding. Simple control.

best in products for

FINISHING

PAINT PREPARATION

PRE-FOS* – Cleans and prepares all alloys for paint. Adaptable to spray-washer or soak-tank use. Surface is uniformly conditioned to provide superior paint adhesion and corrosion resistance.

PHOS-IT – Excellent for wipe-on, wipe-off cleaning and paint preparation. Gives fine etch or "paint tooth," which results in an excellent paint bond.

Dependable Wyandotte products give you better results, shorten maintenance time, reduce operating costs. Send for free technical literature on the Wyandotte products designed to fit your aluminum-finishing operations. Or call in a Wyandotte representative, today. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California. Offices in principal cities.*

*REG. U.S. PAT. OFF.

PAINT STRIPPING

P-1075 – Fast-acting, nonflammable, room-temperature liquid paint stripper with a water seal. Removes most paint finishes without attacking aluminum. Economical – gives extra-long service life.

444-C – Removes paint from large parts or objects quickly. A thickened product for brush or flow-on stripping. Penetrates multiple coats of finishing materials with one application; is nonflammable, water rinsable.

SUPERSOLVE – Removes hard-to-handle enamels and other finishes quickly, without attacking metal. Used hot, diluted with water. Rinses easily.

Wyandotte
CHEMICALS
J. B. FORD DIVISION
THE BEST IN CHEMICAL PRODUCTS FOR METAL FINISHING

WYANDOTTE CHEMICALS CORPORATION
Dept. 3035 • Wyandotte, Michigan

Please send me more information on the following aluminum-finishing operations:

- ☐ Etching
- ☐ Cleaning
- ☐ Desmutting
- ☐ Brightening
- ☐ Barrel Finishing
- ☐ Deoxidizing
- ☐ Paint Preparation
- ☐ Paint Stripping

Name_____ Title_____

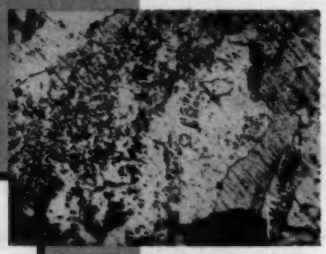
Firm_____

Address_____

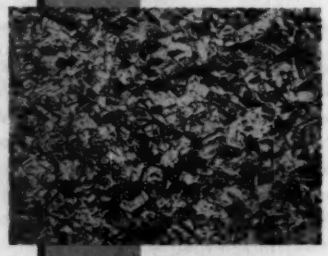
City_____ Zone_____ State_____

NEW SHAPED, EXTRUDED APW SILVER ANODES

STANDARD SHAPES



ROLLED FLAT PLATE ANODE SECTION: This Photomicrograph shows highly irregular, uncontrolled grain size—a major cause of shedding and resultant rough electrodeposits.



APW EXTRUDED ANODE SECTION: Small, fully controlled regularity of grain size promotes uniform corrosion, smoothest electrodeposits, less rejects.

CONTROLLED GRAIN SIZE: APW EXTRUSION PROCESS* controls grain size within definite limits — minimizes sheddings

These scientifically shaped anodes retain 80% of original active surface area after 85% by weight has been plated off!

Costs are lowered by prolonged anode life, minimized polarization and less silver scrap to be refined.

In addition, the APW Extrusion Process controls grain size within definite ideal limits so that corrosion is smooth and uniform. Electrodeposits are *consistently* smooth. Shedding is virtually eliminated. Rejects are a comparative rarity!

We are anxious that the silver you buy in anodes is used most efficiently and economically. Special anode shapes will be engineered to meet your particular plating bath conditions. Call or write for a representative. We'll be glad to assist with your plating problems.

*Pat. Pending

ENGELHARD INDUSTRIES, INC.

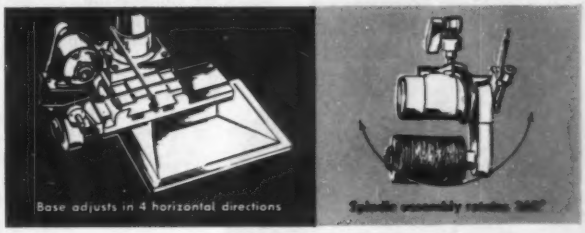
AMERICAN PLATINUM & SILVER DIVISION

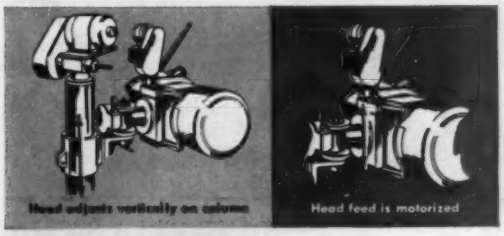
231 NEW JERSEY RAILROAD AVE. • NEWARK 5, N. J.

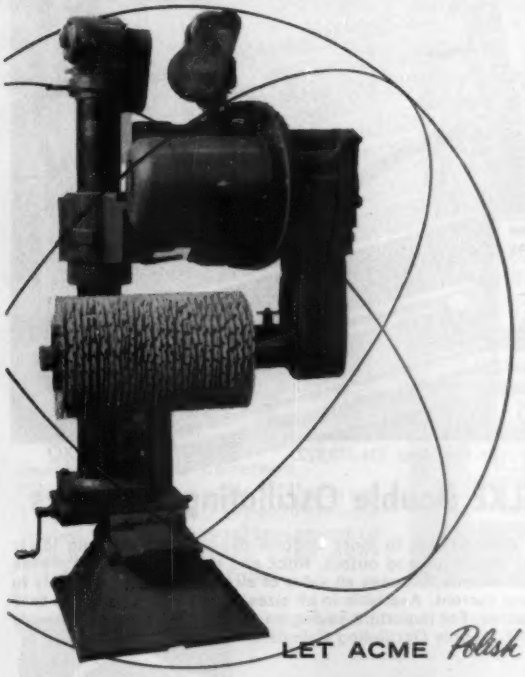
NEW YORK • PROVIDENCE • CHICAGO • SAN FRANCISCO • LOS ANGELES

APW

ACME G-4 KEEPS CONVERSION COSTS DOWN!







If you want machines that will set up for a fast, efficient finishing job on today's work—yet will quickly and easily adapt to next year's designs—ask an Acme engineer to show you the versatile G-4 lathe.

What does the G-4 do? Just about everything! Only four of its many adjustments are illustrated. Without the need for superstructure support, the buffing or polishing head may be faced in four directions horizontally and two vertically. It may be angled to any degree from horizontal to vertical. It may be stationary when it operates, or set for a stroking or oscillating movement. It finishes the most common or the most unusual shapes . . . reduces belt, buffing wheel and compound costs . . . and is ready for adaptation to new designs any time!

An Acme engineering specialist can help you combine these flexible basic units with automatic work-holders or fixtures to give you a set-up for low-cost, high-production finishing. Contact him to discuss your current or anticipated demands. No obligation, naturally.

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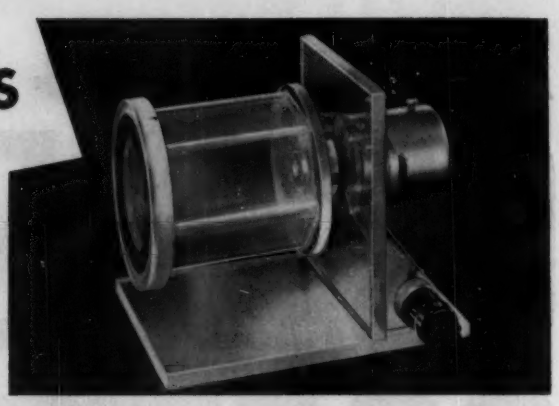
BELKE Rack-Mounted Barrel Plater

Hangs on the cathode rod in a still plating tank like a plating rack. Takes only 6 to 7" space along the cathode rod.

The quick easy way to plate small lots, samples, etc. with no delay; and no production tie-up. Plates any quantity from a spoonful to a pint in practically any plating solution. ..... Just lift out of the tank and pour the work out; reload and hang on the cathode rod.

Cylinder inside dimensions: 4⅞" deep, 4⅛" at small end, 5¾" at large end. Standard perforations, 1/32".

Motor, 115V, 60C, 1 phase.



BELKE Laboratory Bench Burnisher

Fast, economical method of burnishing samples, small lots, costume jewelry, etc. Complete, self-contained unit with cord and plug for 115 V, AC. 4" diameter x 6" Plexiglas cylinder lifts right off to fill or empty. Screw-on cover with gasket seals perfectly. Operates at 45 RPM. Gives wonderful finishing results. Laboratory Oblique Plater also available. Send for literature.

Spring Clamp Cathode Hook

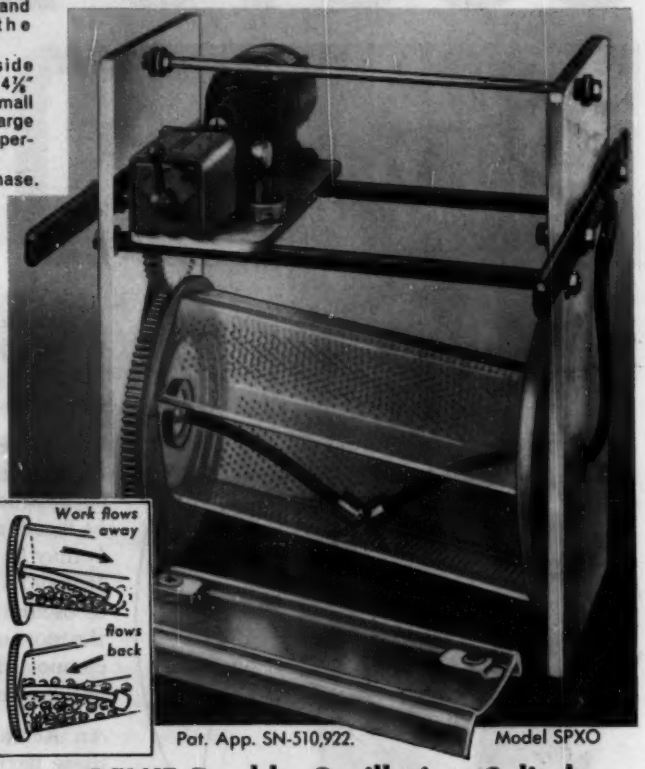
Avoids rejects in chrome plating. Powerful spring tension maintains heavy contact pressure between the hook and the cathode rod for full current conductance. Avoids partial plating and rejects that so often occur with gravity cathode contacts.

Eliminates rack "creeping" and tangled parts when rod agitator is used. The Spring Clamp locks the rack in position—keeps it where the operator places it.

Easy to use. The spring clamp lever fits the grip. Just squeeze to put on or take off the cathode rod.

Easily changed from rack to rack. To install, just cut off present hook and attach the clamp hook with bolts. Available for any size of rack spine and for 1", 1¼", 1½" and 2" cathode rods.

In ordering to fit present racks—specify diameter of cathode rod; also width and thickness of rack spine.



Pat. App. SN-510,922. Model SPXO

BELKE Double Oscillating Cylinders

The sure answer to more uniform deposit of plate with lower costs and increased output. Rock and roll mixing action makes the difference. Exposes all sides of all articles more uniformly to plating current. Available in all sizes from 14x30 regulars to 6x12 portables. For important saving on every barrel you plate specify BELKE Double Oscillating Cylinders.

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The FIRST accepted by the plating industry.

Over 500,000 gallons in successful operation for more than 3 years.

After ten years of research and development, and more than 3 years of production experience, The Harshaw Chemical Company offers a new nickel process answering a major problem of the electroplating industry. You can now deposit *economically* a nickel coating that has high leveling, full brightness, excellent ductility, and most important, superior corrosion resistance. *Only the Harshaw Perflow-Perglow Duplex Nickel Plating Process can provide all of the above characteristics.*

Excellent Corrosion Protection Through Use of a Sulfur-Free Deposit

Years of research work performed by The Harshaw Chemical Company revealed that for satisfactory corrosion resistance the nickel deposit must be *sulfur free*. This fact lead to the development of the Perflow nickel plating process. Further research revealed that the utilization of the sulfur-free deposit as a base coating, following by a bright nickel from a compatable bath, would further improve corrosion resistance. Performance data from a number of leading car manufacturers indicate that the Harshaw Perflow-Perglow Duplex nickel plate is comparable to, and frequently better than, buffed grey nickel, and is unequalled by any bright nickel.

Exceptionally High Plating Speeds

With air agitation, high current densities can be employed, resulting in exceptionally high plating speeds.

Excellent Chrome Coverage

The Harshaw Perflow-Perglow Duplex Nickel Plate is easily chrome plated with no unusual treatment of the nickel necessary even over extended periods of time.

Excellent Leveling

The Perflow-Perglow Duplex Nickel has excellent leveling characteristics which aid in producing bright deposits on poorly polished steel or over dull copper plate. The leveling characteristics can be maintained without sacrificing ductility, brightness, and corrosion resistance.

Outstanding Brightness

Full, bright deposits over a wide range of operating conditions. Even intricate deeply-recessed articles have uniform brightness without shading.

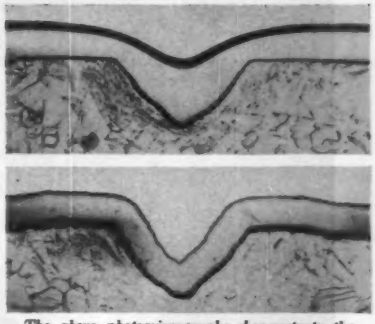
High Tolerance to Impurities

The Perflow-Perglow process has a high tolerance to impurities from the standpoint of both corrosion resistance and overall quality of plate.

Excellent Adhesion

Plating nickel over nickel is no longer a problem. Current can be interrupted without affecting the adhesion. Work can be removed from the plating solution for inspection and put back in the bath without affecting adhesion.

Excellent Ductility at Full Brightness! The ductility of the Perflow-Perglow Duplex Plate is comparable to that of a plate from a Watts nickel bath.



The above photomicrographs demonstrate the leveling effect of Harshaw Duplex Nickel as compared to that of conventional grey nickel.

Top: *Perflow-Perglow Duplex Nickel—depth of scratch 2.7 mils.*

Bottom: *Grey nickel—depth of scratch 2.7 mils.*

MANY OTHER ADVANTAGES!

simplified control . . . stable over extended periods of operation . . . controlled stress . . . uniform protective and decorative plate on both steel and zinc die castings.

HARSHAW'S RESEARCH AND DEVELOPMENT LABORATORY SOLVED THE PROBLEM OF PLATING NICKEL ON NICKEL. THIS COUPLED WITH THE USE OF A SULFUR-FREE NICKEL PLATE HAS MADE POSSIBLE A CORROSION RESISTANT DEPOSIT THAT IS UNEQUALED.

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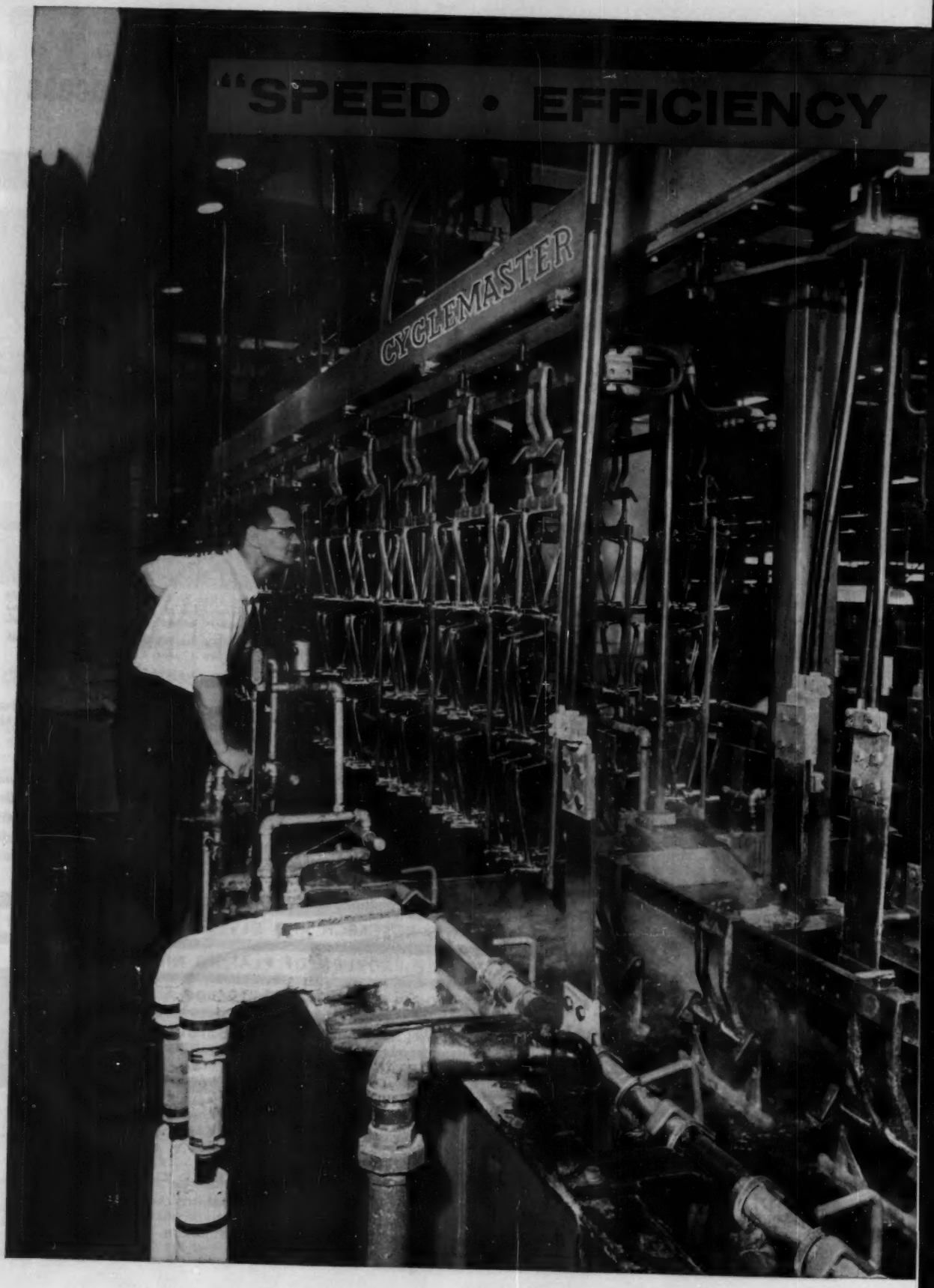
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to Mr. Ken Daly, Vice President and Gen. Mgr.
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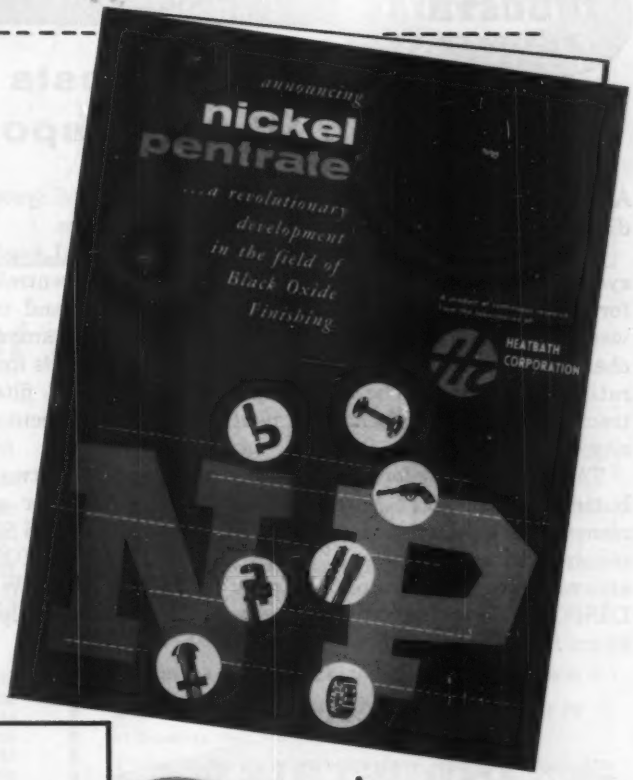

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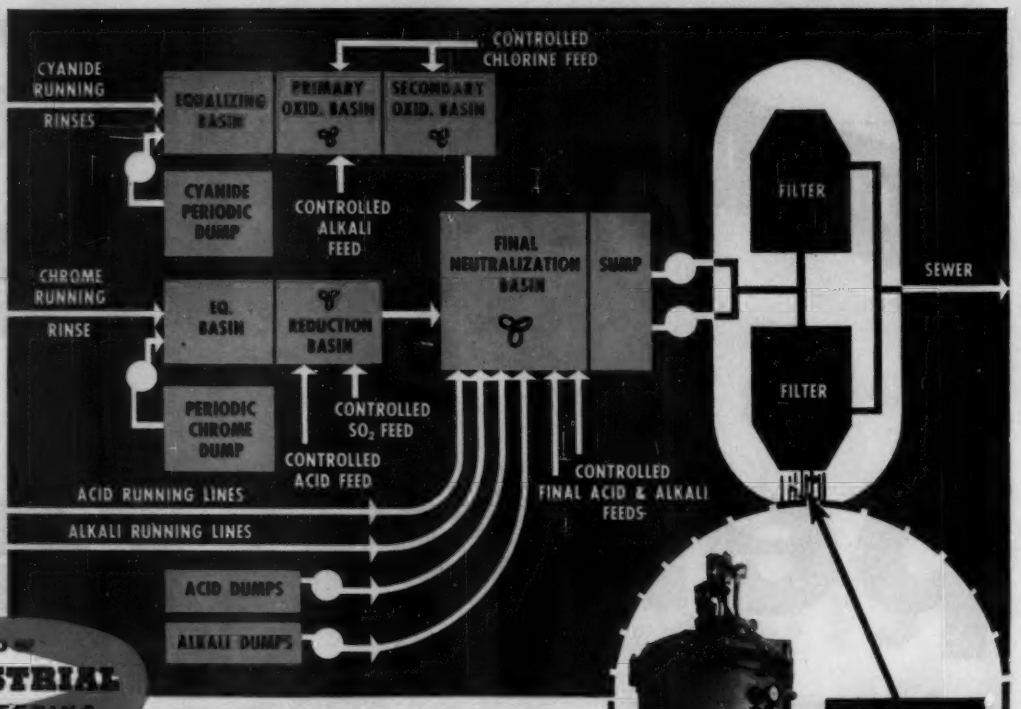

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The answer to their problem was the INDUSTRIAL *engineered system* diagrammed above. This system provides a central basin for neutralization of all the acid, alkali, cyanide and chrome wastes delivered from rinsing operations. Only small amounts of chemicals are added to precipitate the dissolved metals for separation by filtration. The two compact INDUSTRIAL filters extract the solids and discharge a neutral non-toxic effluent to the city sewage system.

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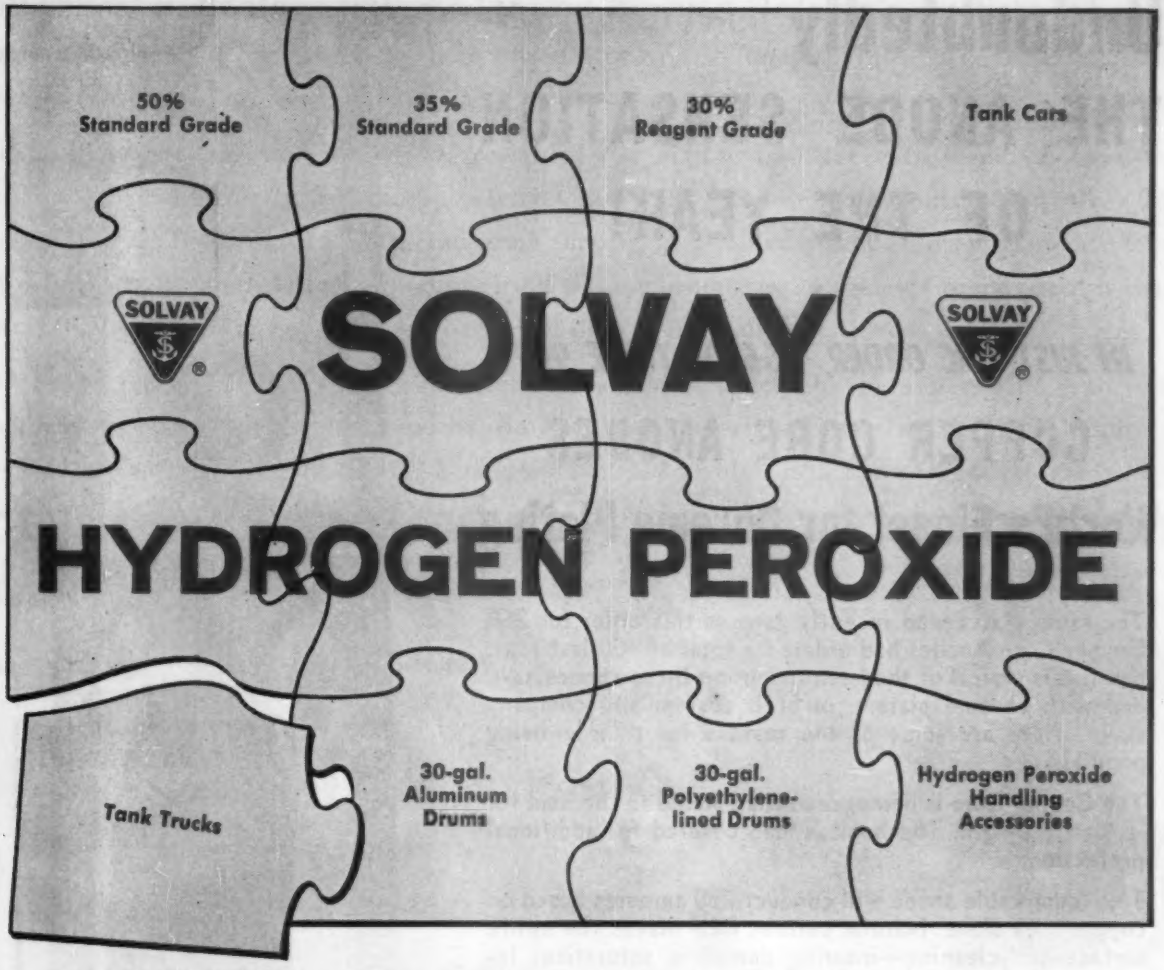

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The Copper Core is homogeneously bonded to the lead for its entire length. The hook is lead covered for additional protection.

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Your Federated representative or distributor will be glad to document this superiority. And you'll prove it for yourself when you standardize on Federated materials. Federated Metals Division, 120 Broadway, New York 5. In Canada: Federated Metals Canada, Ltd., Toronto and Montreal.

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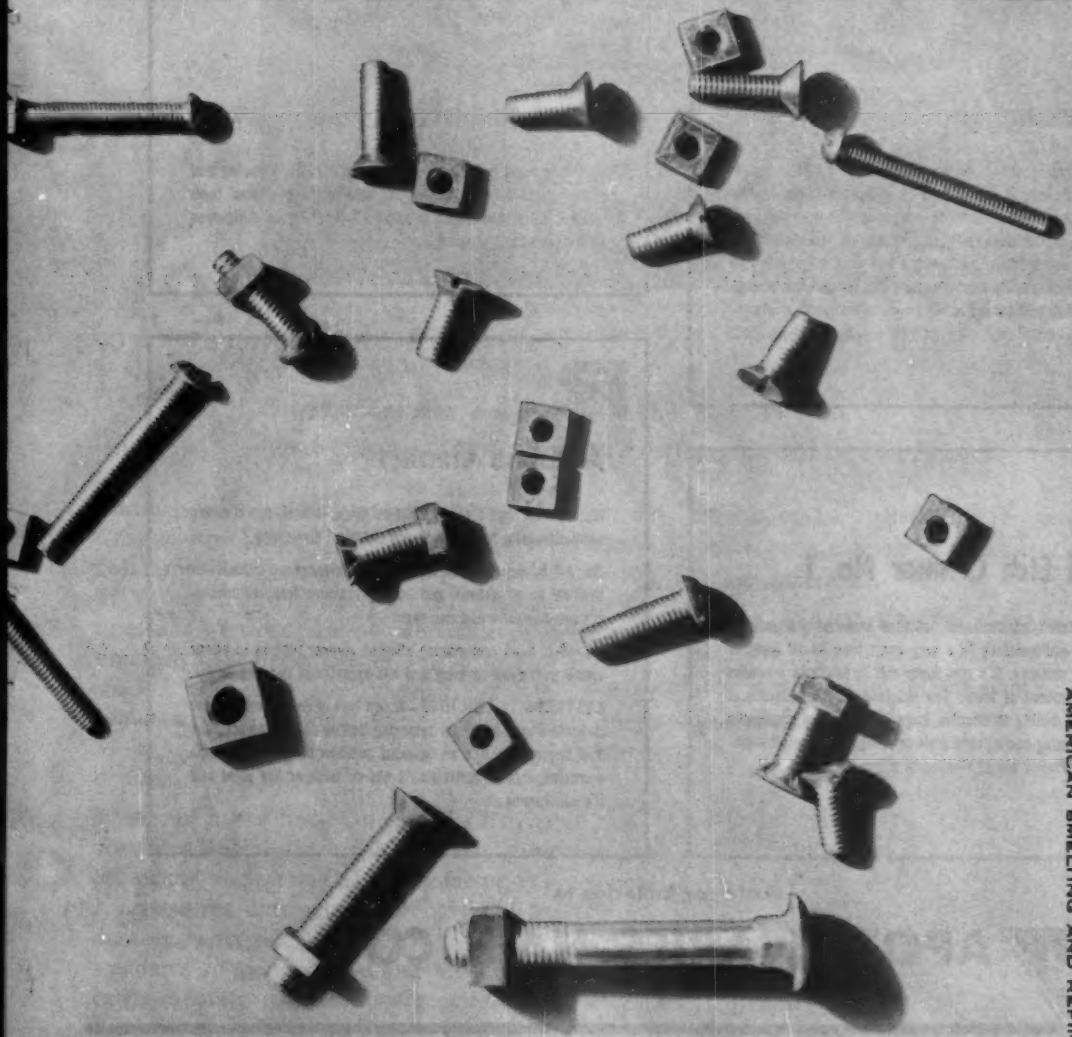

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Federated products for the Plating shop include ANODES: Copper; lead, including the famous Conducta-Core; zinc, tin, tin-lead, cadmium, brass, silver. NICKEL SALTS: Constant quality control assures full nickel content and identical plating characteristics from every lot. PLATING ADDITION AGENTS: Cadmax for still or barrel cyanide cadmium plating; Zimax liquid or powder; Nimax for low cost bright nickel plating; Conmax, a conversion coating, for cadmium and zinc plated parts.

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Rx Ahcoloid Cleaners

No. 189—A non-etching alkaline soak cleaner for cleaning aluminum prior to anodizing and chemical processing.

No. LC-3—An emulsifiable liquid pre-cleaner . . . ideal for removal of oil, grease, and buffing residues from aluminum. It's non-corrosive and non-toxic.

No. 59-H-5—A non-etching alkaline cleaner for use in power washers. It's low foaming and has exceptional cleaning power.

LUSTREBRITE LIQUID 35—A new type of liquid soak cleaner developed specifically for removing buffing compound residues and fingerprints. It's an aqueous solution of non-toxic, non-corrosive, organic materials. It has no flash or fire point and it's non-fuming.

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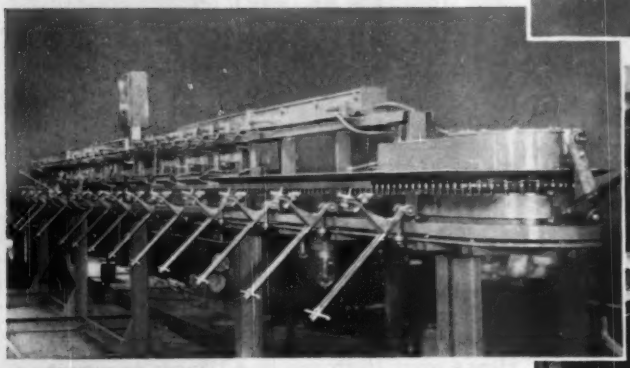

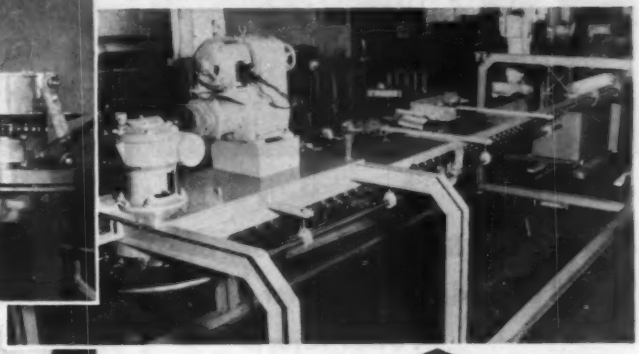

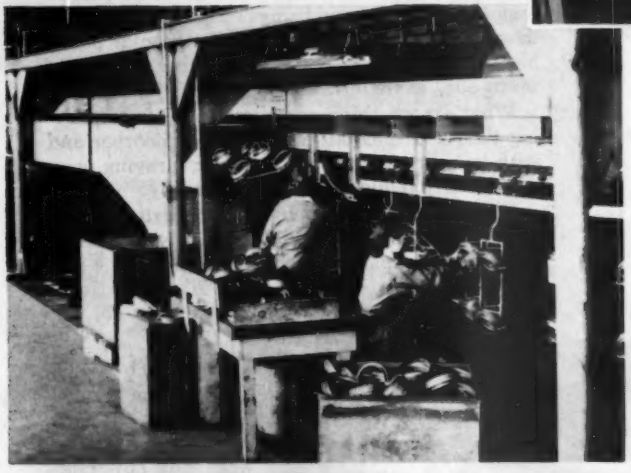

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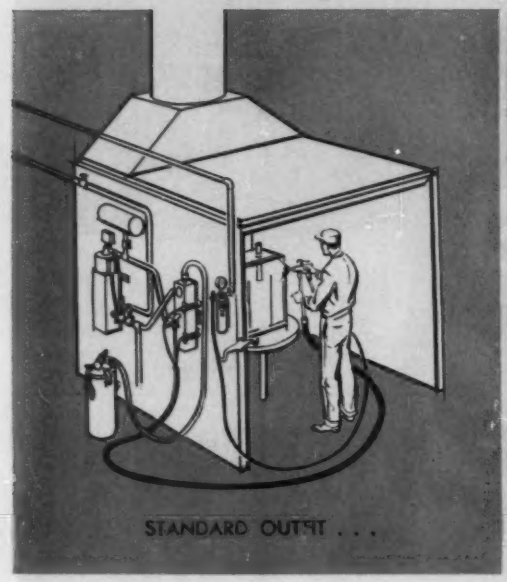

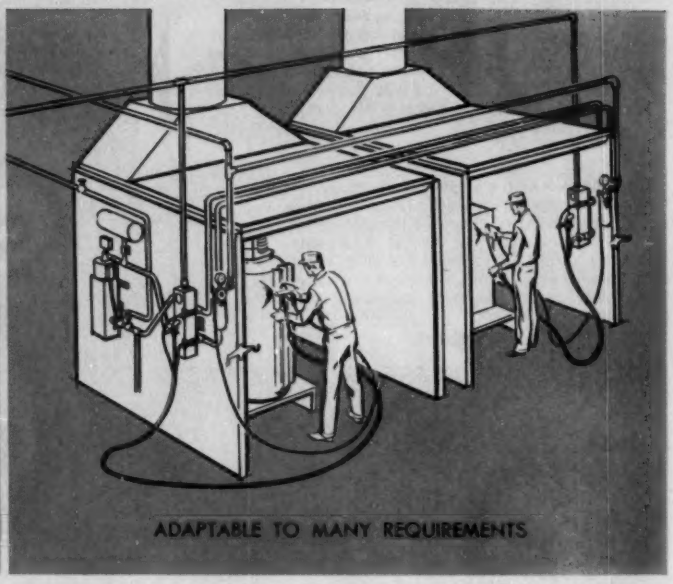

Heavier film builds • Less overspray
Faster drying • Easier application
Fewer rejects
Better flow-out for high gloss

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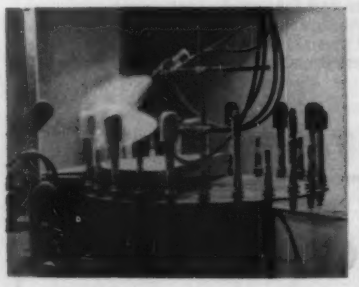
Call our nearest branch today, or write for free booklet, "New Efficiency from Hot Spray." The DeVilbiss Company, Toledo 1, Ohio.



DeVilbiss Automatic Spray Machines coat products of any size or shape quickly, economically, automatically.
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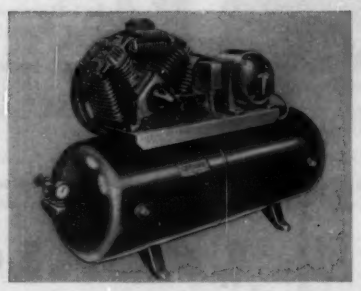

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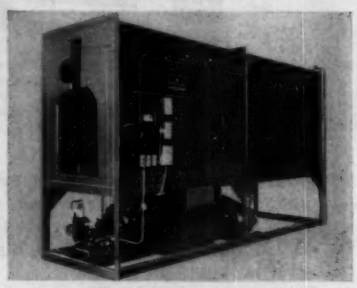

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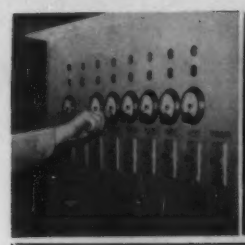

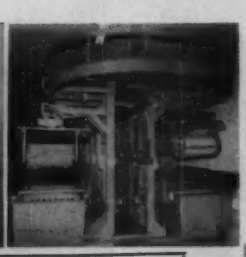

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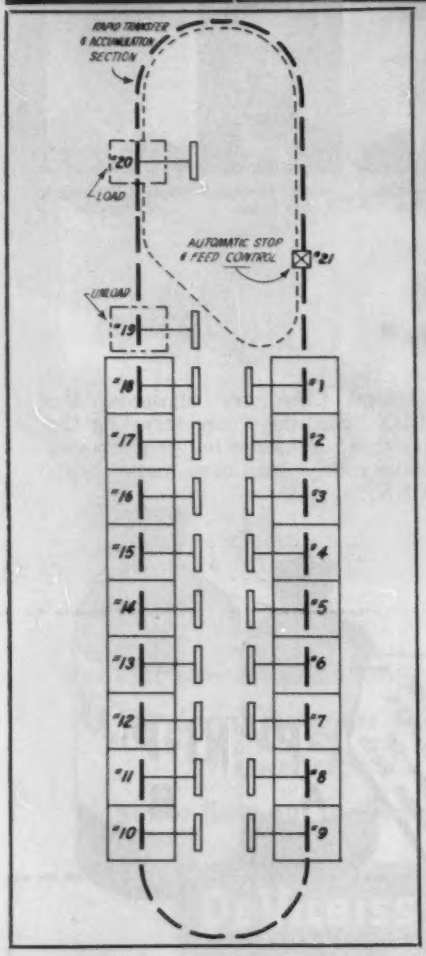

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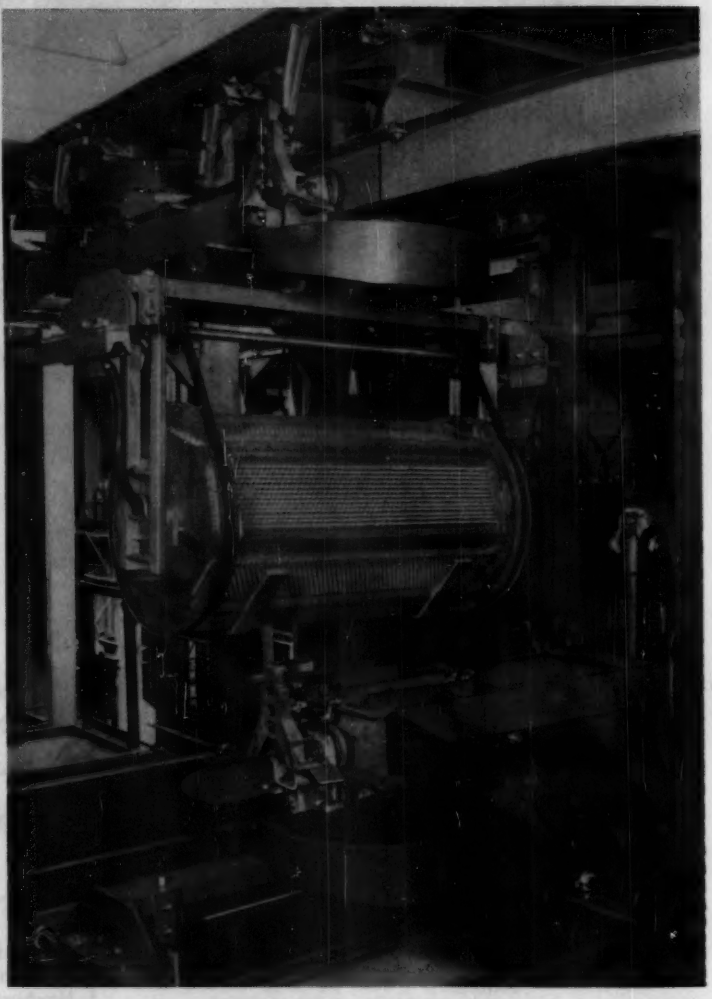
Station	Cycle	Station	Cycle
1	Soak Clean	14, 15	Cold Rinse
2	Hot Rinse	16	Bright Dip
3	Hot Sulphuric	17	Cold Rinse
4	Cold Rinse	18	Warm Rinse
5, 6	Anodic Clean	19	Unload
7	Cold Rinse	20	Load
8	Cyanide Dip	21	Accumulate and Automatic Feed
9-13	Zinc Plate		



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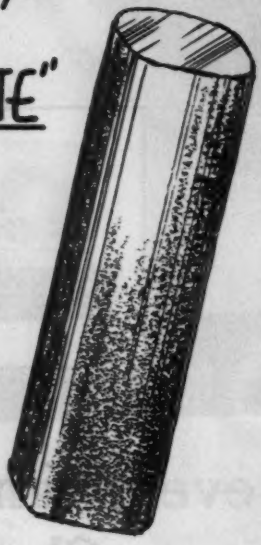

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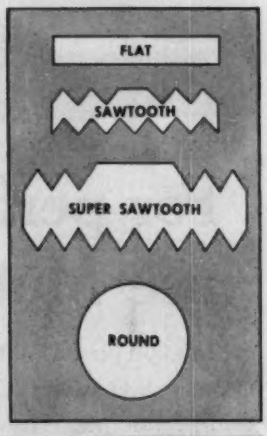

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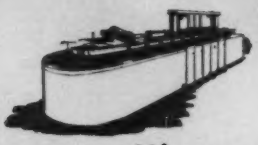

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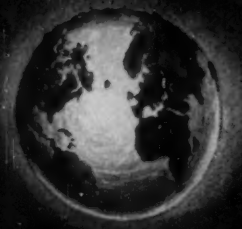

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*Pat. applied for.

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Columbia-Southern Trichlorethylene is available in tank cars, tank trucks, and drums. For further information, write today to your nearest Columbia-Southern sales office or to your solvents distributor.

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Columbia-Southern Trichlor is a quality product, made to extremely rigid laboratory standards. It is available in tank cars, tank trucks and drums. Order yours today from your nearest Columbia-Southern sales office or from your solvents distributor.

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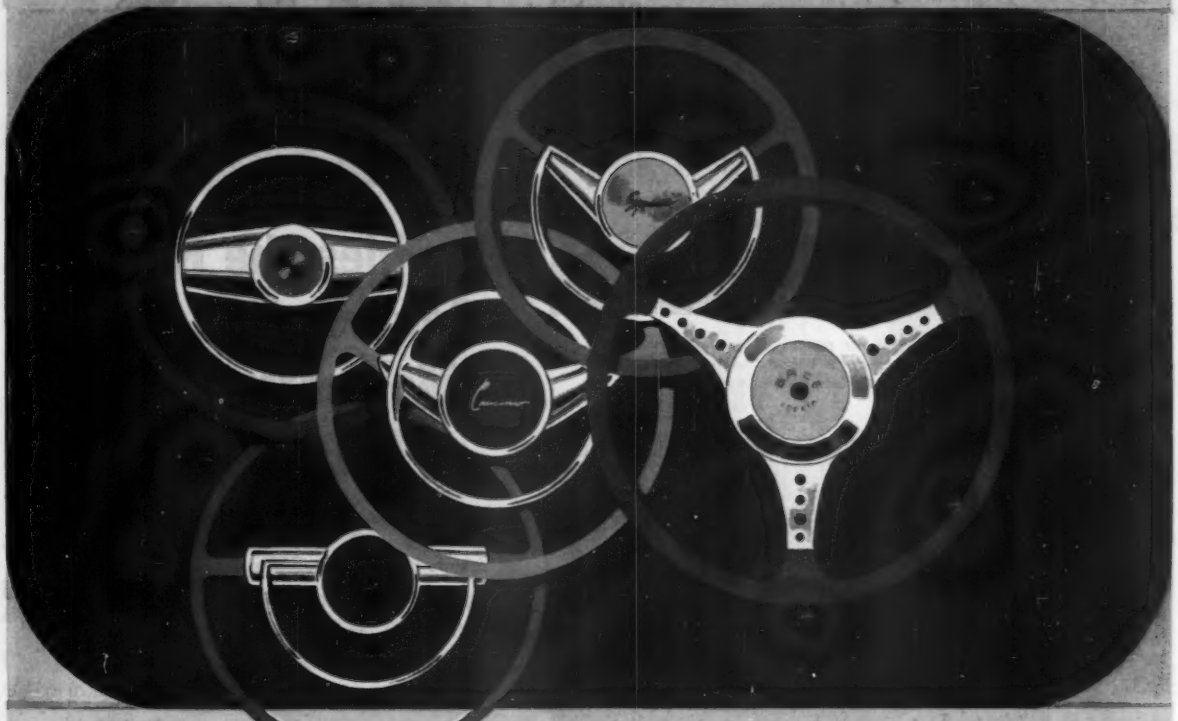

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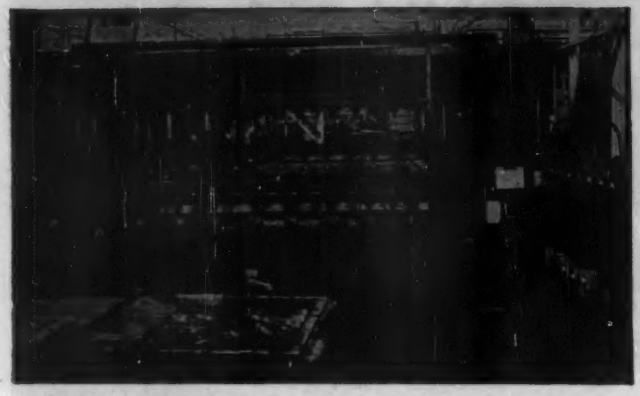

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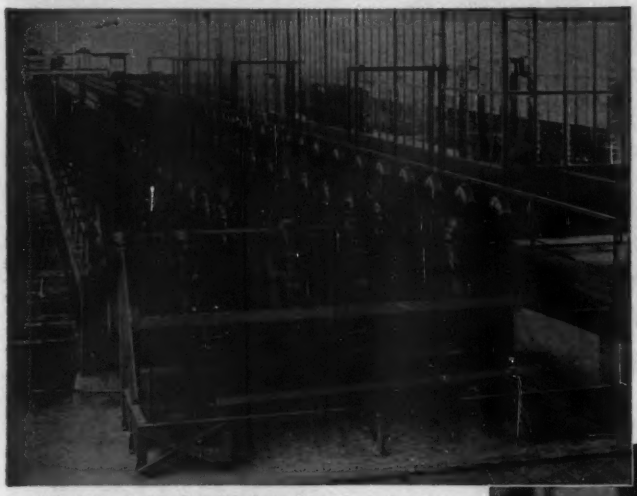

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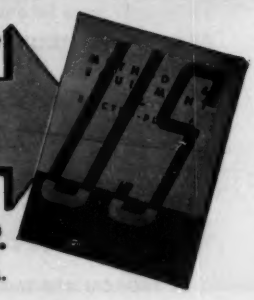

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JULY, 1958 Volume 56 Number 7

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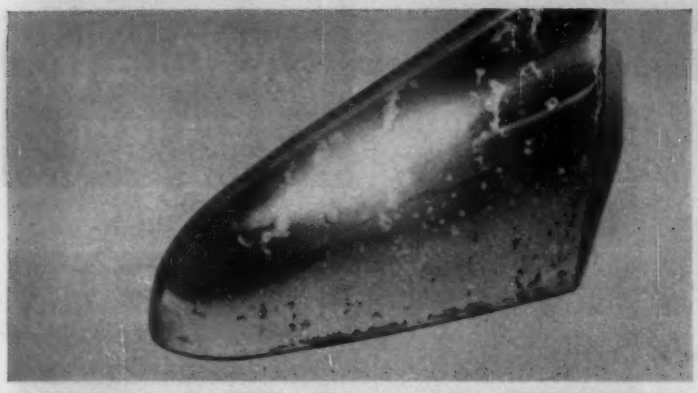
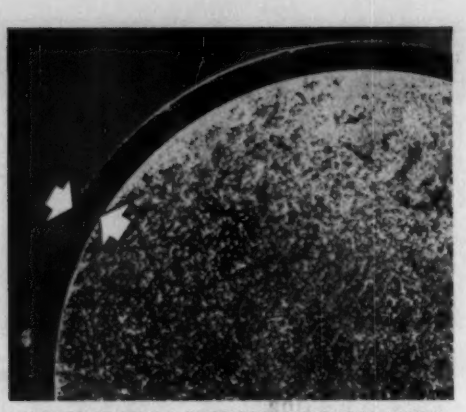
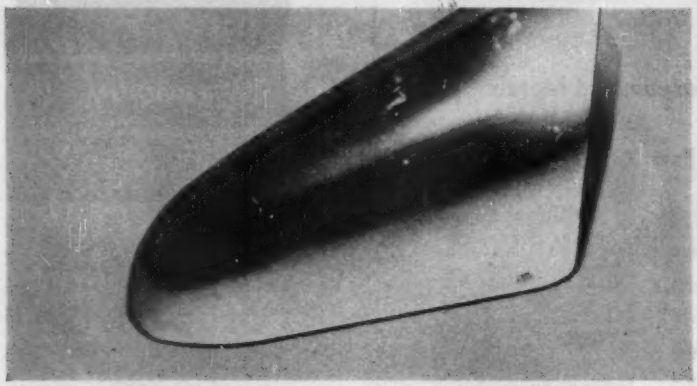
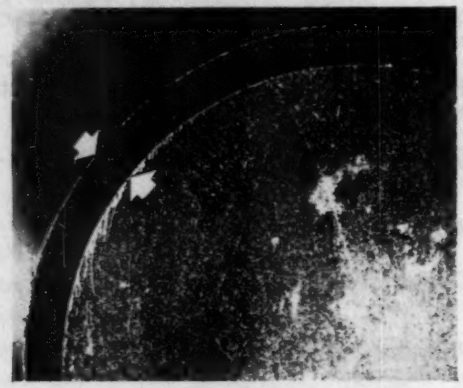


UNICHROME BRIGHT CRACK-FREE CHROMIUM MADE THIS DIFFERENCE IN PROTECTION. Photographs show results of 72 hour acetic acid salt spray test. Part at top was plated with ordinary chromium according to automotive manufacturer's specifications for copper, nickel, chromium finishing. Part at bottom had same copper and nickel deposits but Unichrome Crack-Free Chromium replaced the ordinary chromium, thus greatly increasing corrosion resistance.



UNICHROME SRHS® CHROMIUM MADE THIS DIFFERENCE IN THICKNESS. Enlarged cross sections of identical steel rods show ratio of thickness of plate from ordinary chromium solution (top) to thickness from SRHS Chromium Solution (bottom) . . . a much thicker deposit in the same plating time!





How to get more corrosion resistance from chromium plate

When consumers find fault with decorative chromium plate, it's generally due to early corrosion.

This trouble starts with pores and cracks that occur in all ordinary chromium in the range of thicknesses generally used for decorative plating. Road chemicals, salt atmosphere and fumes find a path right down to base metal. Corrosion starts. As corrosion increases, finish failure progresses, allowing still more corrosion.

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Knowing How to Cut Corners

During the lush years of the seller's market which began right after the end of World War II, the accumulated funds and pent up demand were of such magnitude that the moderating forces of competition were practically non-existent. There was little incentive to cut production costs because price was no object. Now, we are finding ourselves in a situation where labor rates and material costs show very few signs of easing, but customer resistance to prevailing high prices continues to stiffen. Since profit margins, in many cases, are almost at the vanishing point already, and nothing can be done about labor rates or the price of materials, cost reduction in order to permit further reduction in selling price can only ensue as a result of more efficient employment of labor, materials and equipment.

We may be considered qualified to discourse only on the subject of finishing costs; however, since these are usually a very significant factor in determining the selling price of a fabricated article of commerce, the finishing department is worth looking into with an eye toward possible economies. Let us examine the polishing operations first as, probably, the most costly in the finishing cycle. Can a polishing or buffing step be eliminated, without affecting quality? Possibly, starting with a better mill finish sheet or a sounder casting will be less costly. Does the type or quantity call for automatic processing? And, let us not ignore automatic compound application or conversion to the use of liquid buffing compounds as cost reducers. Other questions we can ask are whether a suitable finish can be obtained by barrel finishing and, if not, will its use as a preliminary operation reduce subsequent polishing and buffing costs sufficiently to make it worth while?

In the plating room, an observant supervisor will have no trouble making numerous small corrections which, though of little consequence individually, will add up to a healthy total. Is water being wasted? Are cleaners and acid dips being dumped more often than necessary for lack of simple control apparatus? Will dragout recovery tanks cut plating chemical and brightener expenditures? Are racks with broken tips being sent through the line only partially loaded? These and many, many more conditions are there, just waiting to be discovered and corrected.

The organic finishing section, like the polishing department, is very apt to lend itself to automation, with impressive economy at a relatively small cost. Other factors to be investigated are fuel consumption in the ovens, ventilation efficiency, substitution of dipping or flow coating for spray painting, and the economics of the finishing materials themselves. It is a never-ending source of surprise to us that purchasing agents will insist on buying paints and lacquers on the basis of price per gallon rather than on mileage. Has it been determined whether or not a material costing only a few cents more per gallon will coat many more square feet of surface with the same film thickness? Will a thinner film of a better quality material offer equivalent protective value at a lower total cost?

Some of the conditions we have pointed out can be modified at little or no expense. Others will necessitate an investment in modern, efficient equipment, a decision which will not be made lightly in these lean times. However, and it's been said before, money has to be spent in order to be made!

Nathaniel Hall

Water — Its Use in the Plating Shop

By Lester F. Spencer, *Finishing Engineer, West Allis, Wis.*

IN spite of the tremendous amount of water that is used in the normal plating shop, it is surprising that this essential ingredient is not given more attention. It is generally accepted that raw water contains impurities of various types and in varying proportions depending upon the specific geographical location. These impurities, which may range from 30 to 2,000 ppm. may include:

(a) soluble cations such as calcium, magnesium, sodium, potassium, aluminum, iron and manganese;
(b) soluble anions such as bicarbonate, sulfate, chloride, silicate, nitrate, carbonate, fluoride, sulfide, and hydroxide;
(c) acid constituents such as sulfuric, carbon dioxide and hydrogen sulfide;
(d) dissolved gases such as oxygen, nitrogen, carbon dioxide, hydrogen sulfide and methane; and,
(e) other impurities that may be identified as sediment, turbidity, color, algae, micro-organisms, tastes and odors.

In some instances, the detrimental effect of specific impurities are recognized. Thus, cations such as sodium, potassium, nickel, iron, and bivalent copper are stated to harden chromium deposits, whereas, potassium will harden and chlorine will soften nickel deposits. It is also understood that the presence of foreign material will influence the appearance of plated surfaces in that it may accelerate crystal growth during electrodeposition resulting in roughened, treed, pitted, blistered, or nodular deposits. Although specific mention as to the effect of impurities will be made, as cited by literature, there is an apparent difficulty in setting specific limitations. This may be due to the influence of other factors, such as current density, temperature of operation of the plating bath, additives, etc. However, since water comprises about 70 per cent of a plating bath, it is reasonable to use a purified water to obtain the proper control of this variable by the elimination of impurities regardless of whether they are in suspension or in solution.

There are contaminants in raw water that may be added deliberately to the plating bath as compounds to obtain a specific result. However, it should be realized that it is better to have these additions under control rather than have them added in uncertain quantities in the raw water. A specific example[44] is the addition of carbonate to a copper plating bath. Thus, a definite amount of carbonate must be present to reduce anode polarization, to improve pH control and to prevent attack of iron anodes and tank. However, if the carbonate concentration is too high, plating efficiency suffers and the resultant deposits may be spongy.[21, 23, 24] When too great a carbonate concentration is reached, it has to be removed by refrigeration, precipitation, or the whole bath discarded. Thus, in a bath of this type, which operates at a relatively high temperature and subsequently large additions of water, it is better to use water that is free from carbonates.

Water control is of comparatively recent origin; the first paper to mention the effect of impurities on production plating being made in 1939.[39] Since that time there has been an increasing interest with the net result that the use of water control systems have steadily increased within the last decade. This interest has been motivated by the results obtained in production plating, which would include reduction of rejects, elimination of buffing to remove stains and water spots, a decrease in handling of the plated work, better control of bath, and improved quality of the finished work.

Another phase of water conditioning which is becoming more important is that of waste disposal. Thus, restrictions have been placed on the types of wastes that may be discharged to a sewage treatment plant. This has led to the installation of complete water treatment facilities to existing plating plants. In some instances, especially in the treatment of chromic acid and nickel bearing wastes, the cost of both equipment and installation has been returned in a short time, due to the value of the metallic recovered.

Effects of Impurities

One principle source of impurities in a plating bath stems from the original make-up of the solution from raw water. This source is also present when additions of water are made to allow for evaporation; the amount obtained from a plating bath operating at room temperature is not too great, whereas, the amount obtained in hot, air agitated baths may be as high as 5 per cent.[2, 3] Another source of contamination would be drag-in from preceding rinse baths.

As previously stated, allowable limits of specific impurities are frequently difficult to state with any reasonable amount of accuracy. In addition, it may be

difficult to pin-point the detrimental effect of a specific impurity. However, the data given below may aid in indicating a possible source of trouble. Where additional information is required or, where the evidence presented must be evaluated, it is suggested that the original reference be consulted. The effect of metallic impurities, such as copper and manganese, are given although it is realized that they are infrequently found in water, but may be introduced during a plating cycle.

CALCIUM:

This is one of the elements that contribute to water hardness and causes difficulty due to the precipitates that it forms. Thus, in cyanide copper, this undesirable precipitation will cause roughness and porous deposits.[1] In both the stannate bath and the alkaline tin-zinc stannate-cyanide baths, the calcium precipitates to form a stannate which causes sludge and subsequent difficulties such as occlusions in the deposit and loss of tin.[9] In the latter bath type, the tin to zinc ratio will change. In nickel sulfate plating solutions, calcium is not objectionable as long as it is in solution; however, if the concentration exceeds the solubility limit, the resultant calcium sulfate is reputed to cause pitting, dulling and decreased corrosion resistance of the plate.[1,2,5,14,24] The solubility of calcium in nickel baths is stated to be about 300 ppm.[1,5] In the zinc sulfate bath, calcium at about 700 ppm will cause roughness, treeing and nodules,[21] and it is objectionable in aluminum anodizing baths and subsequent rinses where sulfuric acid is used, the calcium sulfate precipitate marring the finish.[1,21] Calcium carbonate, which is quite insoluble in cyanide plating baths, will cause scaling of equipment.[35]

MAGNESIUM:

Magnesium, which is one of the principal soluble mineral impurities in water, may form a magnesium sulfate which reduces throwing power in chromium baths.[6] When in solution, it will give a softer, brighter plate[2,5,14] in the nickel sulfate bath and, in addition, is reputed to increase conductivity and throwing power.[2,5] However, if the concentrations exceed the solubility limit, the resultant magnesium sulfate may cause pitting, dulling and decreased corrosion resistance of plate.[1] Magnesium acts very similarly to calcium in stannate and alkaline tin-zinc stannate-cyanide baths in that the magnesium stannate will cause sludge and attendant troubles such as occlusions in plate plus loss of tin.[9] The ratio of tin to zinc also will be seriously affected in the latter bath. Magnesium can also precipitate in the cyanide copper bath, which causes roughness and porous deposits. Low corrosion resistance may also occur in the cyanide copper bath.[9]

SODIUM:

The data as to the effect of sodium are rather limited. However, it is stated that sodium sulfate will reduce the throwing power in chromium baths.[6] Its effect in the nickel sulfate bath is reputedly associated with hardness and brittleness of plate.[1,5] In the fluoborate copper bath, two-thirds gram per liter of sodium brightens plate and lowers limiting current density.[12]

POTASSIUM:

Potassium reacts very much like sodium. Thus, this element is reputed to cause hardness and brittleness of the plate when present in the nickel sulfate bath.[1,2,5] In the fluoborate copper plating bath, two-thirds gram per liter brightens plate and lowers limiting current density.[12] This element may also form precipitates which may adversely affect the appearance of the plate.[12]

ALUMINUM:

Aluminum is usually present in such small amounts that it may not be detrimental in industrial waters. However, aluminum anodizing operations with chromic acid will result in a build-up of dissolved aluminum which reduces the speed of anodizing.[9] As to its effect in the nickel sulfate bath, Diggin[2,5] has stated that aluminum in solution has little effect although, as a precipitate, it may prove objectionable at high pH values. An upper limit of 50 ppm has been recommended[16,19] and, in addition, it is reputed to darken and embrittle the plate,[14] presumably when the concentration is sufficient to form a precipitate.

IRON:

Iron, when present in cyanide baths, is reputed to form a sodium ferrocyanide precipitate[45] and, in other instances, may form a ferric hydroxide precipitate.[24] The effect of iron will vary; in the cadmium cyanide bath a concentration of 4000 ppm will cause hazy deposits which becomes increasingly worse as the concentration increases;[5] in the cyanide copper bath, iron above 0.75 g./l. will cause coarse crystalline plate, reduce anode efficiency, and is difficult to remove from the bath;[9] and, in the silver cyanide plating bath, even small amounts of iron will stain deposits.[5]

Iron will precipitate as an iron sulfate in chromium plating baths, which reduces the throwing power.[6] Aproberts[7] has stated that iron in concentrations of 3 to 400 ppm can increase covering power; however, at 1500 to 2000 ppm, covering power is reduced. It has also been stated by several references[8,9,10] that iron can cause poor conductivity within the plating bath. The effect of iron on the nickel sulfate bath is disastrous in that it will cause pitting, streaking, burning, roughness, codeposition, poor adhesion and brittleness.[1,5,9,14,16] There apparently is little agreement as to the upper limits of iron in nickel baths. Williams and Sherry, as quoted by Smith,[1] have placed an upper limit at 20 and 40 ppm respectively; a supplier[16] has placed this value at 50 ppm; Diggin[5] at 70 ppm; another supplier at 100 ppm; and, Roehl[19] from 100 to 200 ppm. However, since it is generally conceded that iron can be most troublesome in the nickel plating bath, every effort should be made to exclude this element. The effect of iron in the nickel fluoborate bath is also detrimental in that its effect is similar to that experienced in the standard nickel plating bath; however, apparently it is not as disastrous.[1]

The effect of iron on the zinc sulfate bath is a lowering of plating efficiency and an effect on cathode deposits; this occurring at about a concentration of 10 ppm.[21] In the acid copper bath, iron is reputed to cause

rough deposits[1] and, in addition, reduces cathode efficiency and affects the structure of the plate.[5] In the cobalt-nickel bath, Smith[1] has given an upper limit of 200 ppm. It should be realized that build-up of iron within a plating bath may be quite rapid where the operating temperature is between 120 and 160°F. Thus, under these conditions, water replenishment may be as high as 5 gallons per 8 hours of operation per 100 gallons of electrolyte.[4]

MANGANESE:

Data on the effect of manganese in plating baths is also limited. Available information indicates that it can lower the limiting current density in the fluoborate copper bath[12] at about 3 g./l. In the nickel sulfate bath, manganese causes rough deposits;[14] in the zinc sulfate bath, manganese over 350 ppm will result in defects such as treeing, nodules, and roughness of deposit;[21] and, in the iron bath, the upper limit for manganese is given at 5 g./l.[27] Herwig[27] has also indicated that a manganese content below this limit will increase the ductility of the iron deposit.

COPPER:

Bright nickel plating baths are less tolerant to copper as an impurity than are the gray nickel baths; the usual defects associated with this metal is a darkening and roughness of plate. Ewing and Gordon[14] have given 7 ppm as the amount of copper that is tolerated in bright nickel baths while 35 ppm will cause dark and rough deposits. A value of 380 ppm is also stated as tolerable in gray nickel plating baths. It has been reported[28] that 10 ppm will cause dull plate; values from 10 to 25 ppm will decrease ductility of plate; and, where the content is above 75 ppm, a decrease in hardness of plate and reduction of corrosion resistance is experienced. Other investigators have reported an upper limit for copper from 10 to 50 ppm[16] and at 40 ppm.[19] It has also been reported that copper will reduce salt spray resistance.[25]

In chromium plating baths, copper sulfate will reduce throwing power;[6] lower the salt spray resistance of chromium over nickel plate;[25] and, may reduce conductivity.[8,9] The effect of copper in cyanide solutions varies, staining may result in cadmium cyanide baths[1] and is responsible for dark plate in bright dips and reduced throwing power;[5] in gold cyanide solutions, it changes the color of the deposit;[26] in silver cyanide baths, copper from 2000 to 3000 ppm is tolerated but may darken the deposit when the concentration reaches 7500 ppm;[5] and, 75 ppm may cause sludge in the zinc cyanide bath with subsequent poor appearance of the plate.[5] Stoddard[27] states that the upper limit for copper in iron baths is 50 ppm.

SILICA:

Silica, which is found in almost all natural waters, can impair the plating efficiency of cyanide plating baths,[21] Diggin[5] reporting that this compound causes spotty and dull deposits in baths operated at 180°F. It is objectionable in nickel sulfate baths only when it precipitates and, in this form, it may cause pitting.[1]

CHLORIDES:

The usual chlorine content in tap water is under 200 ppm; however, water replenishment to compensate for evaporation and drag-out losses rapidly builds up the chlorine content to amounts over the allowable maximum. It has been stated[9] that it is essential to have a low chloride content in water used to make cadmium and copper fluoborate baths. It causes poor deposits; contributing to roughness of plate in the chromium baths;[5] nodular deposits in acid copper;[5,29] and, in acid tin, where the chlorides are from 15 to 20 grams per liter, a crystalline deposit results. The effect of this compound in the zinc cyanide bath is that of anode polarization,[1,9] reduced efficiency[21] and corrosion.[9] In nickel fluoborate baths, 1 g./l. of chlorides will cause pitting.[20] Chloride content in the silver cyanide bath should be less than 25 ppm since it contributes to the corrosion problem.[1,31] It has also been stated that high concentration of chlorides will cause iridescent deposits in silver cyanide baths.[5]

CARBONATES:

The effect of carbonates in cyanide plating solutions is a decrease in plating efficiency and the production of spongy deposits.[21,23,24] In both the cadmium and copper cyanide solutions, the generally accepted range for carbonates is from 2 to 8 oz./gal.; above this limit it will cause restriction of the current density range for bright plate and high drag-out losses[1] in the cadmium cyanide bath, whereas, loss of anode efficiency and corrosion will result in the cyanide copper bath. In the zinc cyanide bath, excessive carbonate will result in a hard and embrittled plate.[21] Gordon and Roberts[22] have placed an upper limit of 60 to 70 g./l in brass cyanide baths. Both Diggin[2] and Morral[21] have stated that either carbonate or bicarbonate at a pH less than 4 will cause cracking, embrittlement and impaired cathode purity.

SULFATES:

The maintenance of the sulfate-chromate ratio in chromium plating baths is well known,[6,9] and it is generally conceded that water-borne sulfate will affect this ratio. In the lead fluoborate bath, sulfates may cause rough deposits and harmful precipitates.[34,35]

NITRATES:

The effect of nitrates in the chromium plating bath is a restriction of the plating range and the production of rough plate.[5] In the nickel sulfate bath, this compound may reduce throwing power, and increase hardness and cracking tendencies of the deposit.[14] It has also been claimed that nitrates may adversely affect additives[14] and cause pitting.[5]

AMMONIA, PHOSPHATE, FLUORIDE AND DISSOLVED AIR:

Work on these impurities have been performed with the nickel sulfate bath. Ammonium contributes to the hardness and cloudiness of plate;[5] a concentration of about 50 ppm of the phosphate radical will cause a frosty deposit[36] and a darkening of plate;[14] fluorides in the form of a calcium compound will form an objectionable precipitate;[1] and, dissolved air is not considered too objectionable unless bubbles are formed on the work, which may cause pitting.[2]

CARBON DISULFIDE AND HYDROGEN SULFIDE:

In order to emphasize how small an amount of a contaminant is required to disturb a plating bath, an excess of 0.0001 oz./gal. of carbon disulfide brightener in a silver plating bath will cause a discolored and hardened deposit.[4] The stated excess is equivalent to about 0.75 ppm. Many waters have 50 ppm of this compound which is over 60 times the concentration stated. As to hydrogen sulfide, Ewing and Gordon[14] have indicated that the range from 200 to 600 ppm is satisfactory, but larger amounts may darken the plate and cause rough deposits.

ORGANIC MATTER:

This objectionable impurity is removed by adding activated carbon and filtering; this procedure will absorb wetting agents which must be replaced.[4] Apparently, this impurity has a disastrous effect on many plating baths, among which we would include: the cadmium cyanide bath, where dark, cloudy or pitted deposits results;[5] the silver cyanide bath, producing dark, rough, streaky deposits; cyanide copper with attendant streaks, ridges, burning,[5] and pitting;[9] cadmium fluoborate where streakiness and bad color in plate is obtained;[9] brittle plate in fluoborate copper;[9] pitting, burning, and streaking in nickel fluoborate baths;[20] in nickel sulfate baths, where clouding, pitting and streaking is obtained;[1,2,14] and, the reduction of hexavalent to trivalent chromium in the chromium plating bath. Oil is reputed to cause streakiness in pyrophosphate copper.[9]

Water Conditioning

There are various methods employed to condition water; some being limited as to both application and results. The method selected for any specific application should be made after an engineering analysis to assure that the selection will be sound from both a technological and economic viewpoint. A water conditioner will represent a substantial investment in both initial equipment and installation and, on the premise that a wise decision has been made in selection it frequently becomes a paying proposition. There are several types and combination of types that are available; the following discourse will deal with the more important types.

The sodium cation exchanger is the most widely used of all water softening processes; this process is frequently referred to as the "zeolite" process. The water flows by gravity through a bed and both the calcium and magnesium ions are held by the zeolite. In turn, it gives an equal number of sodium ions to the water, with the result that the effluent usually has less than 2 ppm hardness. Since the reaction is a reversible process, the exchanger bed is regenerated with salt to replace the calcium and magnesium ions with sodium, thus converting the bed to its original state. It has also been stated[38] that the sodium cation exchanger has the ability to remove soluble ferrous iron and manganous ion, these impurities being removed simultaneously with the hardness. In addition, the regeneration process will remove these impurities as divalent chlorides. This method also is widely used with other processes, such as the cold lime process, the hot lime process, and the hydrogen cation exchanger.

The hydrogen cation exchanger, which may be operated either under pressure or by gravity feed, operates very much like the sodium cation exchanger with the exception that hydrogen ions replace calcium, magnesium, and sodium ions. Similarly, it removes other ions from the raw water, such as ion and manganese. In the event that sulfate or chloride anions are in the raw water, the effluent will have a corresponding amount of sulfuric and hydrochloric acid which either has to be neutralized or removed. In accordance to Nordell,[38] this can be accomplished in two ways, namely, by neutralization with caustic, either by alkali feed or the use of a sodium cation exchanger in which the effluents of both units are mixed in a calculated amount, and by the use of an anion exchanger. This latter process, which is known as "demineralizing" will be discussed in detail.

Brief mention will be made of both the cold and hot chemical processes. In the first category, the cold chemical processes would include: the cold lime, which reduces both calcium and magnesium alkalinity; the cold lime-soda process may be used to reduce both carbonate and non-carbonate hardness; and the two stage process utilizing cold lime and sodium cation exchange equipment will soften the water to almost zero hardness and reduce both total solids and alkalinity. The hot chemical processes would include the hot lime-soda, the two stage hot lime-soda and phosphate process, and the two stage hot lime-soda and sodium cation exchange process. The hot processes will operate with greater efficiency than the cold processes in that removal of the objectionable anions that cause water hardness along with the alkalinity is to a lower level. The net result obtained from the hot chemical procedures as compared to the cold chemical methods are similar, with the exception of the stated lower level content. In addition, the hot lime and the hot lime-sodium exchange unit will reduce silica to about 1 to 2 ppm. For a detailed explanation as to both operation, equipment and performance of these processes, it is suggested that reference 38 be consulted.

Sequestration is fairly well known and it is applied frequently both as a primary treatment or as a secondary conditioning after the water has been softened by other methods. Hexametaphosphate, polyphosphates, such as sodium tripolyphosphate and gluconic acid, are employed to render harmful impurities ineffectual. Organic sequestration by the addition of organic chelating agents will also remove metal ions as highly stable complexes which are thus rendered harmless. An example of this reaction type is the addition of chelating agents in certain nickel baths in which copper, iron, and magnesium are rendered ineffective. Engel[4] has stated that the addition of 10 grams of E.D.T.A. per liter of Rochelle copper will complex undesirable metallic impurities and thus increase the bright current density range. When added at a similar concentration to the fluoborate tin bath (0.2 pH, 80°F., 30 amp./ft.^{2}), this chelating agent improves the deposit and, when added to a gold cyanide bath, it suppresses copper to obtain the desired karat deposit. These chelating agents may be chosen to preferentially complex iron,

copper, and other impurities. They are usually very stable and are not even attacked by strong alkalies.

Demineralizing

One of the more popular methods of conditioning water is by the ion exchange demineralizing process which involves the passage of raw water through resin beds producing conditioned water that is free from hardness and dissolved mineral content. Due to the low cost and uniformly high quality, demineralized water is displacing distilled water for many purposes. Other advantages include simplicity of equipment design, size availability to deliver any quantity of pure water, automatic operation requiring only limited attention for the regeneration of the resins, and a relatively low cost of initial equipment. This type of equipment is standard for producing conditioned water for make-up of plating solutions, purifying and reclamation of metallics in rinse water, and the conditioning of solutions to be discarded. Its cost of operation will vary with the amount of dissolved solids in the water and the degree of purity that is required.

The process is, basically, a two step operation. The first step is a hydrogen ion exchange in which the cations in the water are replaced by hydrogen ions, whereas, the second step consists of an anion exchanger in which the anions are changed to the hydroxyl anion. Thus, all of the impurities are removed from the water. Regeneration of the resin in this equipment type is obtained by the use of an acid such as sulfuric for the cation unit, which requires acid proof equipment, while the anion exchange resins are regenerated with a solution of alkali such as sodium hydroxide or sodium carbonate.

There are three types of demineralizers which operate quite effectively, each type having specific limitations and advantages. Thus, these units would include: (1) a two bed unit using a weak basic anion exchanger; (2) a two bed unit using a strong basic anion exchanger; and, (3) a mixed bed. The first type, which is diagrammatically illustrated in Fig. 1, will not remove carbon dioxide or silica. Since carbon dioxide can be removed by air stripping it from the water in an apparatus called a degasifier, or by the use of vacuum in a vacuum degasifier, this impurity does not prove troublesome. Silica, which is infrequently in excess of 25 ppm,[1] is not considered too objectionable in plating baths since it is inert. An advantage of this type demineralizer is efficient and inexpensive regeneration with soda ash.

The second type demineralization unit is employed when the removal of silica is mandatory. Carbon dioxide removal is assured by the use of a degasifier between the cation and anion exchanger units. Regeneration of the highly basic anion unit is obtained with sodium hydroxide; the efficiency of regeneration is much less than that realized with the weakly basic type anion unit.

As is indicated by the name, both the cation and highly basic anion exchangers are in the same unit in the mixed bed type demineralizer. One of the advantages of this unit is the extremely pure water obtainable; the intimate mixing of the cation and anion exchange resins permits multiple and alternate contact with the raw water. Regeneration of this type of bed is preceded by hydraulic classification because the cation exchanger is of higher specific gravity than the anion exchanger. After separation, sodium hydroxide will regenerate the anion exchanger by passing the solution through the upper layer, whereas, an acid performs the same function in the cation exchanger by passing it through the lower layer. A distributing spider mounted at the position of the interface of the two layers is used in this operation.

The type 1 demineralizing unit is capable of producing water that will contain 5 to 10 ppm of ionized solids from the usual water supply, a carbon dioxide content of about 5 ppm and the original silica.[1] Type 2 demineralizer will produce a water that has about the same or slightly less ionized solids, a silica content as low as 0.01 ppm and no free carbon dioxide. According to Smith,[1] the residual ionic compounds from both processes are either alkali metal chlorides, carbonates, or hydroxides. The mixed bed demineralizer produces a water of the highest purity and, on the basis of resistivity measurements, the ionized solid content is less than 0.05 ppm, a silica content as low as 0.01 ppm, and no free carbon dioxide. The table illustrates a comparative analysis of both a raw water and the effluent of the three deionizing units discussed. Basic demineralizing units are also illustrated in Fig. 2.

Ionized organic matter, such as acetates, will also be

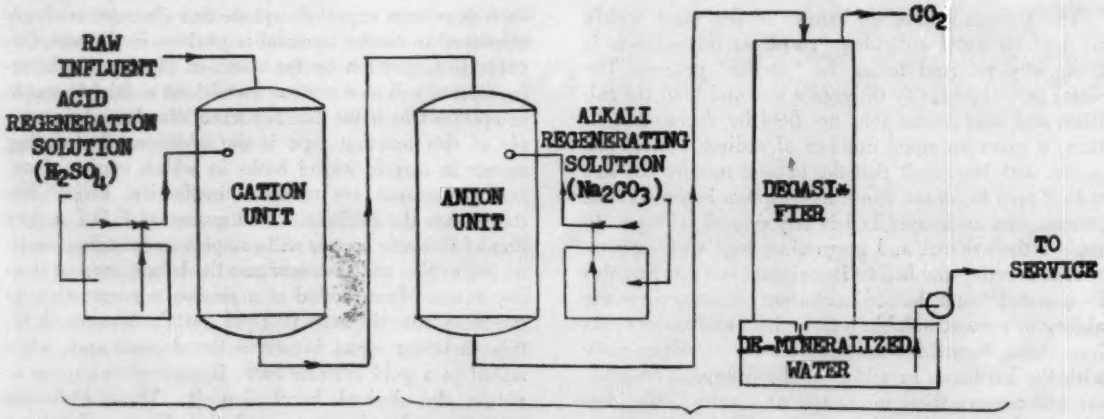

Fig. 1. Flow diagram of demineralizing process.

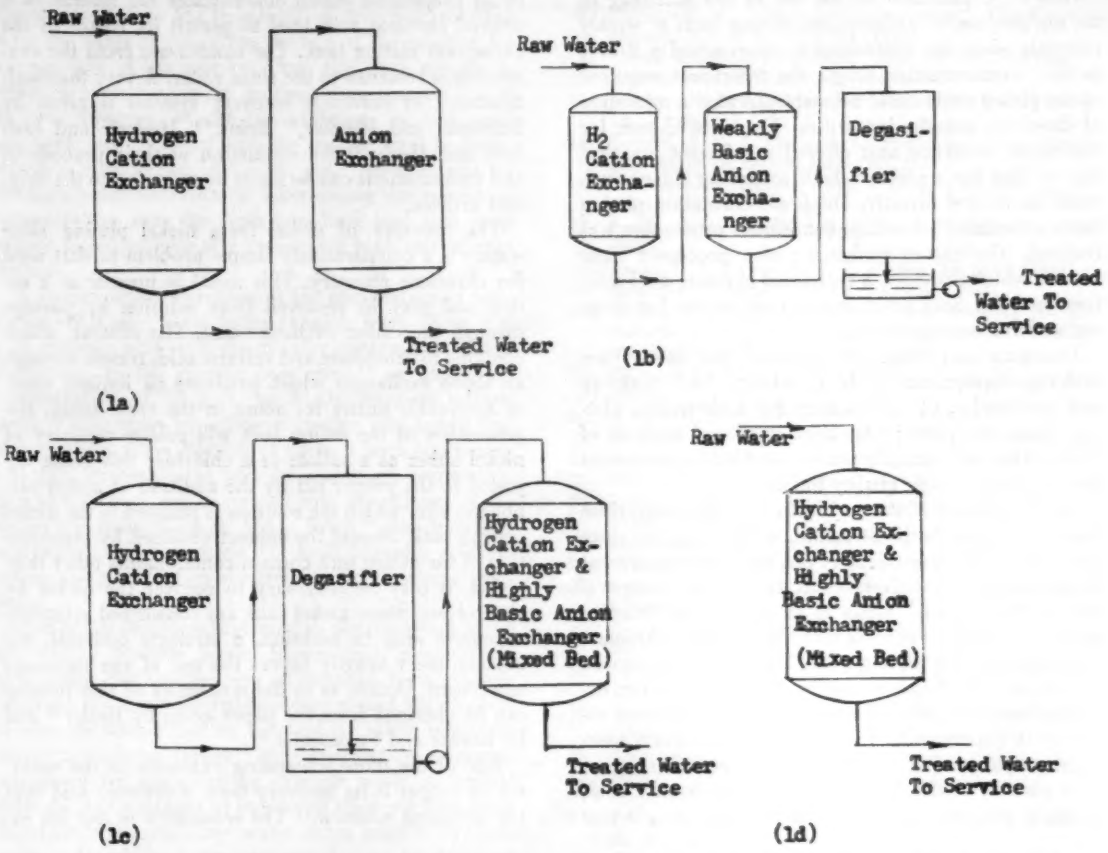

Fig. 2. Basic demineralizing system arrangements include (1a) two step without degasification (1b) two step weakly basic anion exchanger with degasification; (1c) demineralization and silica removal-hydrogen exchanger with degasifier and mixed bed unit; (1d) mixed bed unit.[37]

removed by demineralization. In addition, where the molecular size of organic compounds is such as to permit diffusion into the ion exchange particles, their removal from a raw water is possible. However, these units should not be used as filters even though they can remove a certain amount of suspended matter. Smith[1] recommends the use of a filter as a preliminary operation where the turbidity of the water is about 5 to 10 ppm.

Analysis of Raw Water and a Composite Analysis of Waters Made During a Typical Cycle of the Three Deionizing Units[46]

Constituent	Raw Water	Weak Base	Strong Base	Mixed Bed
Calcium	180	1	1	Less than 0.01
Magnesium	152	2	2	Less than 0.01
Total hardness	332	3	3	0.01
Sodium	2	1	1	0.04
Bicarbonate alkalinity	278	3.5	4	0.03
Hydroxide	0	0	0	0
Sulfate	31	0	0	0
Chloride	18	0.5	0	0
Nitrate	7	0	0	0
Free carbon dioxide	10	250	0	0.02
Silica	12	12	0.02	0.02
Iron	0.6	0	0	0
pH	7.49	4.90	8.25	6.97
Turbidity, ppm	1.3	0.1	0.1	0.1
Color, APHA Units	2	0	0	0

Economic Considerations

A number of methods for the conditioning of water has been discussed; the type selected being determined by an analyses of a specific need. However, the use of ion exchange equipment and resins in the metal finishing field has developed to an accepted and general practice. In instances, especially in its use for primary bath make-up, the benefits obtained are not benefits upon which an immediate dollar value can be placed. Thus, the use of demineralized water in primary baths will eliminate many of these variables (metallic and non-metallic contaminants) that frequently lead to difficulties and, in many instances, a build-up of these contaminants within a bath will ultimately result in discarding of the bath.

The more spectacular economic balance sheet is the conditioning of rinse waters that contain valuable metallic contaminants; the net result is that the installation cost as well as the initial investment is returned in a period of 1½ to 2½ years by virtue of the recovery of the metallic salt. Thus, in the last ten years, a partial listing in literature would include recovery processes for chromic acid rinse waters[11,37,40,42,43]; nickel rinse waters[42]; chromic acid copper stripper solution;;[11] chromic acid anodizing solutions[11,40]; copper, zinc and cadmium cyanide rinses[42,43]; and, mixed barrel plating wastes.[42]

Hesler[42] commented on the use of ion exchange in the purification of a chromium plating bath at weekly intervals when the contaminants approached a 2 to 4 oz./gal. contamination level; the tolerances required of the plated parts could be met only with a minimum of dissolved metallic impurities. The resin chosen for the cation exchange unit offered a sufficient practical life so that the undiluted bath analyzing 33 oz./gal. could be treated directly. Duplicate chromium plating baths were installed so that continuous production was realized. The cation exchanger also processed rinse waters, which provided a reclaimed chromic acid solution used for bath additions to compensate for drag-out and evaporation losses.

Bueltman and Mindler[37] reported the use of ion exchange equipment for both primary bath make-up and purification of rinse waters for a chromium plating set-up; the parts plated were small and intricate of design, that subsequently were assembled in equipment that required a high quality finish.

Many examples of the purification of chromium rinse waters are given in the literature, which is logical since recovery of the investment of ion exchange equipment is realized in a relatively short time. The incorporation of "save rinse" tanks is an established practice and will normally conserve 60 to 90% of the chromate dragged from the plating tank. The remainder can be recovered as a chromate salt by the use of an ion exchange set-up. A typical flow diagram of chrome recovery is illustrated in Fig. 3; the reclaim rinse passing through a cation exchange which frees the solution from metallic contaminants. The purified chromic acid, which is at a concentration of about 2 oz./gal., is sent to an evaporator which concentrates the effluent to a desired chromic acid level to permit its return to the chromium plating tank. The condensate from the evaporator is returned to the rinse water. A very thorough treatment of chromate recovery systems is given by Bueltman and Mindler,[37] Brink,[40], Hesler[42] and Ledford and Hesler.[11] An evaluation of their procedures and computations can be made by referring to the original articles.

The recovery of nickel from nickel plating rinse waters is a comparatively simple problem to that used for chromate recovery. This metal is present as a cation and may be removed from solution by passage through the cation exchange unit. The effluent, which contains hydrochloric and sulfuric acid, travels through an anion exchanger which produces an ionized water of acceptable purity for reuse in the rinse tanks. Regeneration of the cation unit will realize recovery of nickel either as a sulfate or a chloride; this being adjusted to the proper pH by the addition of nickel carbonate, after which the solution is pumped to the nickel plating tank. Should the effluent obtained by regeneration of the cation unit contain contaminants other than nickel, it may be necessary to recover the nickel by electrolysis. Since nickel salts are considered relatively expensive and, in addition, a strategic material, the balance sheet heavily favors the use of ion exchange equipment. Details as to the economics of this process can be obtained from the paper given by Hesler[42] and by Reents and Stromquist.[33]

One of the more interesting examples in the recovery of copper is its recovery from a chromic acid copper stripping solution.[11] The economics in the ion ex-

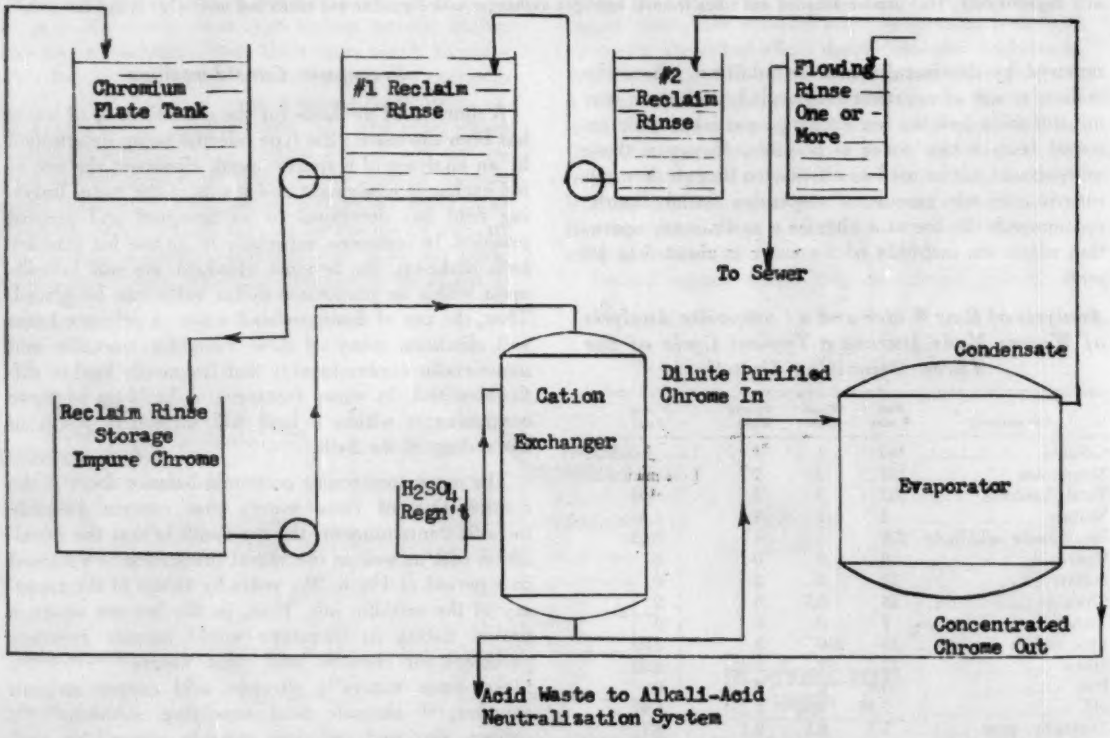

Fig. 3. Chrome recovery flow diagram.[11]

change method in the treatment of this type solution is on the basis of extending the life of the solution by the removal of the copper. Thus, this bath usually is replaced when the copper concentration exceeds 5 to 6 oz./gal. However, by the ion exchange method, contaminants are removed and the copper level is maintained at a maximum of 2.5 oz./gal. This level was set through experimentation in determining the maximum concentration that the bath can hold and still strip copper plated articles at a reasonable high rate of production.

A similar type of problem is the purification of anodizing solutions; these baths ranging from 75 to 100 g./l. chromic acid with the metallic contaminant being aluminum. In the specific case cited,[47] an aluminum concentration of 12 g./l., as Al_2O_3, requires adjustment. Purification by cation exchange was found feasible without prior dilution of bath; a bath containing 100 g./l. chromic acid and an aluminum contamination of 6.95 g./l. was processed with the effluent of the cation unit being 0.2 g./l. Al_2O_3. Brink[40] also described equipment and procedures for both chromic acid recovery and purification of chromic acid anodizing solutions.

One of the problems that exist in plating shops is the removal of cyanide waste. Reents and Stromquist[33] have stated that the recovery of metallics from cyanide solutions is not considered economical and the disposal of cyanide wastes can be handled by other relatively simple procedures. Hesler[42] indicated that ion exchange equipment for conditioning cyanide waste is limited since there is a danger of poisoning the resin bed when the cyanide bearing rinse water is too high in cyanide content. In addition, the equipment must be designed to prevent the escape of hydrocyanic acid that may develop during processing. Bueltman and Mindler[37] also have indicated that the treatment of cyanide bearing waste from plating bath rinses requires careful study if the ion exchange system is employed. If the cyanide content is at a low concentration level, ion exchange equipment may be used. However, if the concentration exceeds an allowable limit, depending upon other contaminants present, pretreatment prior to ion exchange is recommended. The establishment of this limiting cyanide content must be established through experimentation and its importance cannot be overstressed.

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Factors Affecting Residual Stress in Electrodeposited Metals

A Critical Evaluation

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This is the fourth and concluding installment of Dr. Kushner's article. The first three parts appeared in the April, May and June issues, respectively.—*Ed.*

Stress After Effect and Hydrogen Uptake

It has been pointed out by Hoar and Arrowsmith[56] and by Vagramyan and Tsareva[29] that tensile stresses in a deposit in tensile stress will increase slightly when the current is shut off and that likewise, when a deposit is in compressive stress, the stress will tend to show an "after effect" by becoming more tensile when the current is shut off.

Vagramyan and Tsareva attribute this phenomena to the fact that the atoms on the surface have more mobility than those below the surface and, when the current is shut off, these surface atoms have enough mobility left to cause the change in stress.

This after-effect phenomenon was investigated with the Stresometer with a number of deposits in tensile and compressive stress and the results are shown plotted against time after the current was shut off, in Fig. 18.

As can be seen, the maximum change is reached in five minutes or less after the current is shut off. It can also be seen that the shape of the curve, regardless of whether the stress is high or low or tensile or compressive, is about the same.

Another point of interest is that the percentage change in stress seems to increase as the stress becomes more compressive in nature. Thus, in the top curve for a nickel chloride deposit, the stress goes from 26,000 to 26,600, a change of 2.3%. In the next curve for a sulfamate deposit, the stress goes from 12,000 to 12,800, a change of 6.66%. In the next curve for a copper deposit from a copper sulfate bath to which thiourea was added, the change is from —7,600 to —6900, or 9.2%. In the final curve also for a copper deposit but at higher initial compressive stress, the change is from —10,000 to —8,300, or 17%.

What is the cause of this phenomenon? Because of the same general shape of the curve it is believed to be an electrolytic phenomenon. What is believed to be happening is this: After the current is shut down with the instrument still in the solution, the diffusion film remains for a while and, while it remains, we can have in effect a concentration cell between higher and lower areas of the surface. The higher areas become cathodic to the lower areas and some metal is dissolved out from the lower areas and, along with it, comes some of the matter between the grains, so that the stress is increased. The metal that is dissolved is redeposited on the higher spots. In addition, grain boundaries will be anodic to interior regions of the metal grains.

Such a system would work as shown in Fig. 19. It would continue working until all the solution in the hollows was at the same composition level as that at the peaks, which would be for a few minutes duration. As was pointed out previously, matter between the metal grains would be released during this process

FIGURE 18

Stress "After-Effects" for Various Baths

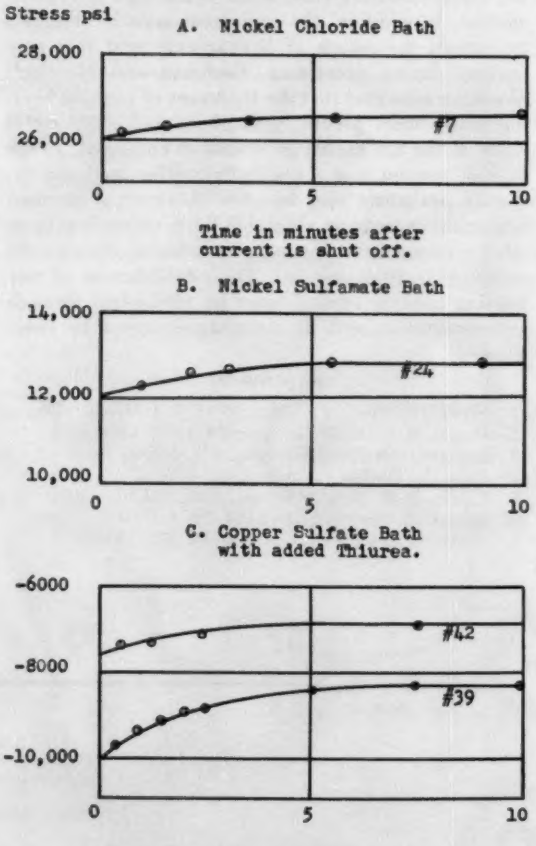
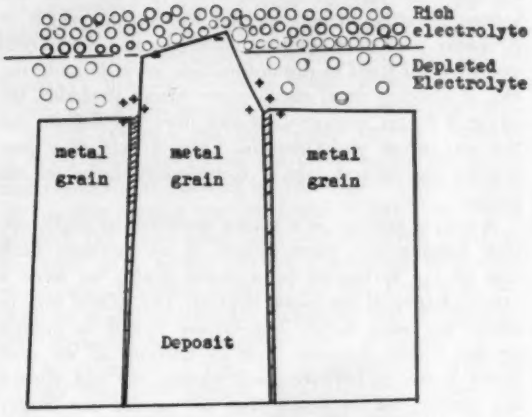


FIGURE 19

Explanation of the Stress After Effect



High spots in deposit protruding into rich electrolyte become cathodic with respect to low spots in depleted electrolyte. Also, stress at grain boundaries makes these regions anodic.

and this would cause the stress to rise slightly. With more matter between the grains (in the more compressively stressed deposits) more would be released per unit amount of metal redissolved, so that the change in stress would be greater. This would account for the greater change in the stress with the deposits more compressively stressed.

The curves and the percentage relationship are, by the same token, strong evidence that foreign matter is a potent factor in the production of stress in electrodeposited metals.

Hydrogen Effect

It was mentioned in the theoretical discussion at the start that Kohlschutter and other investigators found that, when hydrogen was plated out on a nickel deposit in tensile stress from a dilute acid solution, the strip contractometer immediately lost its curvature and returned to its unstressed state. On the basis of these experiments a number of workers developed a hydrogen theory of stress, as mentioned there. It was decided to check on this by plating out hydrogen on stressed nickel deposits to see what would occur.

For this purpose two types of baths were made up, one of 10% sulfuric acid in distilled water, and one of 10% potassium carbonate in distilled water. Tests were made on a number of nickel deposits, from a sulfamate bath and from a chloride bath. The freshly plated deposits were rinsed in distilled water and the instrument was lowered into the hydrogen plating bath at 25°C., and the current turned on. One determination was made at 40°C.

The results of these experiments are shown in Fig. 20. The percentage reduction in the original stress has been plotted against the ampere-minutes of hydrogen plating.

What can be seen at once is that, regardless of the conditions and the deposit used, the residual stress cannot be completely reduced to zero, as was stated by some of the earlier investigators. Probably, the only reason it did vanish is because they plated out relatively thin deposits of nickel in the first place.

The maximum change that could be arrived at was found in a chloride deposit, curve F. A limiting reduction of about 27% of the initial stress could be arrived at in a carbonate solution. No further reduction in a reasonable length of time could be obtained by any of the hydrogen treatments and the stress returned to normal rapidly at first, on shutting off the current, but never came back fully to the original reading. This occurred only on standing overnight.

From these results, it appears that hydrogen as such cannot be the main cause of the residual stress. If the original stress was caused simply by the fact that hydrogen entering the lattice at the time of plating spreads the metal atoms apart and, on diffusing out, leaves them in a state of tension, then the entrance of hydrogen into the lattice once more should relieve completely or almost completely all of the residual stress, even though only temporarily. It did not.

Suggested Theory for Cause of Residual Stress

As a result of the experiments made and an examination of the literature it is suggested that the following reasons may be the cause of residual stress in electrodeposited metals:

1. There are two basic mechanisms at work to cause residual stress. The first mechanism is that of lattice misfit in the early layers of the deposit. On the clean surface of the substate metal, the depositing metal atoms must contract or expand their normal lattice structure to conform with the lattice of he basis metal. This is mechanism one, which accounts for the high stresses observed in the first 100-200 Å of the deposit.

2. The second mechanism at work is the interference of *water* itself with the deposit. It is postulated that water in the aquo complex or in the shell surrounding the ion may remain parasitically attached to the metal atom at certain cites such as discontinuities, grain boundaries, etc., in the cathode structure. Lyons[57] has given a mechanism by which such a process may occur.

It has been shown that much water is included in chromium deposits that is not driven off until high temperatures are reached.[58] Mathers[47] points out that water is carried to the cathode in the form of complex cations and ion sheaths and gives some of the factors that influence the structure of these entities.

Lyons also gives a mechanism by which the nickel aquo complex may be converted to $NiO{\cdot}2H_2O$ by the release of hydrogen ions from coordinated water molecules. A compound such as this included in the deposit, plus a little free hydrogen, could readily account for the 8 ± 2.6 to 1 ratio of oxygen to hydrogen found by Brenner et al.[37] The water not converted to the oxide by the mechanism suggested, being

parasitic in a strange lattice, will diffuse out, the amount diffusing out depending on the amount present (its rate of production and the conditions in the cathode film.)

The amount of hydrated nickel oxide plus other residue such as chlorine, is a measure of the amount of water that was originally held at the lattice discontinuities and imperfections and, if much remains, much was held originally. In turn, this means that, where more was held, the tensile stress will be higher because more will leave from the discontinuities, so that the shrinkage will be even greater. Conditions at the cathode film, if they are such that more parasitic water molecules reach the areas of deposition, will cause higher stresses than if they are such that less can reach the area of deposition.

Additional evidence that can be cited in favor of this idea is this: It is a known fact that ferrous ion will raise the stress in a nickel deposit much more than will ferric ion. Examination of the literature shows that ferrous ions carry with them approximately 60 water molecules in their ion sheath, whereas ferric ions carry only 21,[59] and ammonium ions carry more than sodium ions (ammonia is a strong stress raiser). The picture is complicated by the fact that, at different pH values, more or less water may be carried[60] and colloids will likewise influence the amount of water carried by each ion.[61] The degree of hydration, likewise, will be influenced by temperature. If the degree of hydration is reduced by higher temperatures, the reduction in the tensile stress of the nickel deposits can likewise be readily explained.

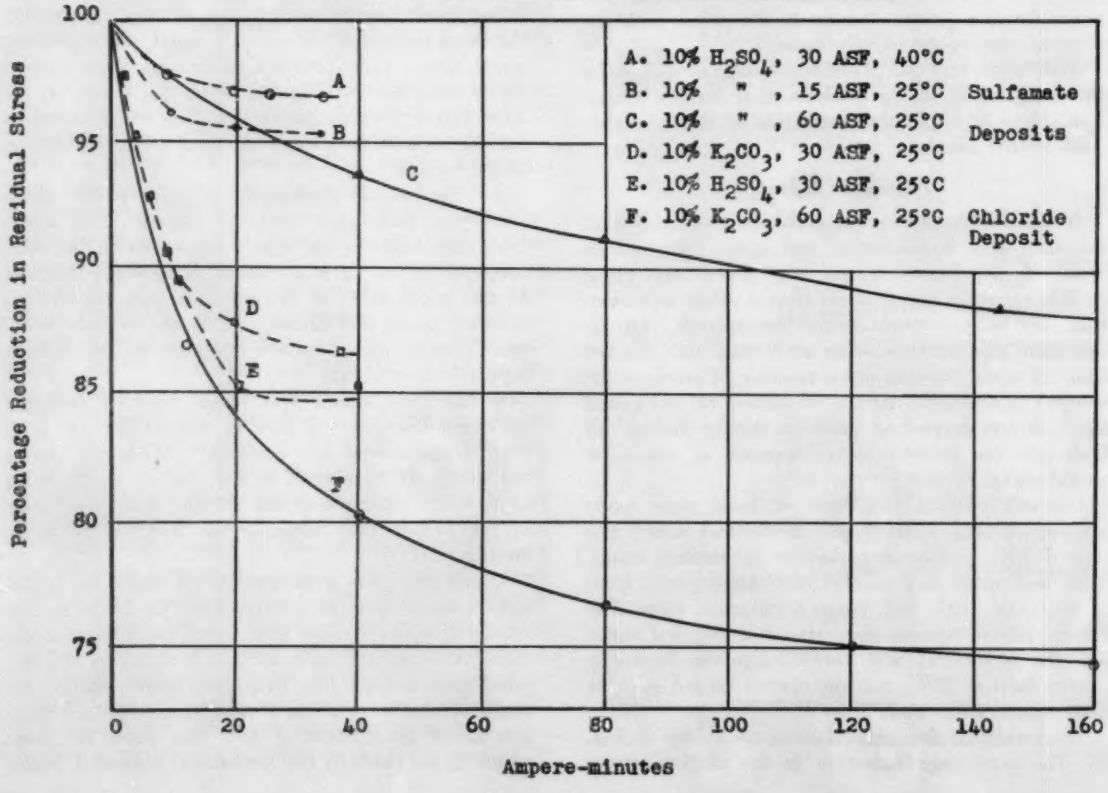
With this theory, compressive stress obtained by the use of addition agents is readily explained. As was first seen in Fig. 13 for nickel containing saccharine, the usual high tensile stress is produced by the conformation of the atoms in the first few layers. Shortly thereafter, the saccharine which is probably part of a complex cation is also discharged and attaches itself to discontinuities, grain boundaries, etc. It attaches itself much more firmly probably because it forms a compound and does not diffuse out the way water molecules do. Thus it acts as a permanent wedge and puts a compressive force on the grains.

A simple analogy is a spring stretched in slight tension between two fixed pillars. If we consider each coil of the spring to be a metal grain, we have a crude picture of the metal deposit. The pillars are, in effect, the basis metal. The deposit spring is pulling on the pillars because it is in tension. If we now insert a wedge between each spring, we can spread the spring out so much that the spring no longer pulls on the pillars; it pushes them; i.e., we have put the deposit in compression.

The original tension that is in the spring is put there at the time the deposit is formed. Trapped coordinated groups (essentially water molecules) decompose partially or leave the metal lattice and, in so doing, bring about a reduction in volume (an

FIGURE 20

Effect of Hydrogen Deposition on Residual Stress



action similar to removing the wedges between the coils of the spring) and, thus, throw it into tension. In other words, the trapped water molecules act like transient wedges. Addition agents such as saccharine, etc., replace the transient water wedges with more permanent chemical compound wedges which cause the deposit to remain in compression.

Compressive forces in zinc deposits can be explained by the same mechanism, except here the wedges formed between the spring coils are not as transitory due to the more ready formation of an oxide, so a permanent compressive stress is produced.

Strong evidence for this theory that the stresses in electrodeposited metals are produced by the action and behavior of residues of coordination compounds or complex cations, can be found in the relationship between the stress after-effect and the stress itself, in the tests on a nickel solution containing saccharine or similar addition agent (Fig. 13), and the fact that, on moderate heating, nickel deposits in compressive stress return to tensile stress.[62]

The evidence of Fig. 13 is particularly striking. In the first few seconds of plating the forces are those of lattice mismatch, and the nickel is in tension. As saccharine is increased in concentration at the cathode, permanent type wedges are formed at lattice discontinuities and the deposit goes into compression. Where the discontinuities are more plentiful (finer grain size, more dislocations, of the cold-rolled specimen), the stress rises to a higher compressive value than where the discontinuities are less plentiful (annealed specimen). Likewise, the same basic process is evident in a copper solution containing thiourea (Fig. 14).

Summary of Results

1. An equation has been proposed giving the relationship of residual stress with thickness of deposit and it has been proposed that the stress characteristics of a certain deposit be given in terms of a limiting stress A and the characteristic length 1/k where k is the exponent in the equation $S_a = A + Be^{-kt}$.

2. There appears to be no relation between the known effect of anions on overvoltage and the residual stress in nickel deposits which, apparently, invalidates the excess energy type theories.

3. Very low temperatures have a drastic effect on the cathode film, greatly lowering the cathode efficiency in nickel deposition and producing very high stresses near the interfacial region (100-200Å).

4. Very low current densities, likewise, cause high tensile stress but not in as great a degree as does low temperature.

5. Accordingly, at lower temperatures, the temperature is a much stronger influence on stress than is current density (this bears out the findings of Mahla in work done at Lehigh University[63]).

6. Impurities and contaminants can drastically effect the residual stress in electrodeposits. It is suggested that, while adsorption and compound formation is probably the underlying action, contaminants such as saccharine are carried to the cathode as parts of complex ions.

7. Surface cleanliness has a marked effect on stress behavior, as indicated by the Stresometer. On the basis of the results, a new method for measuring bonding strength may be feasible.

8. Surface finish, as such, has no marked effect on residual stress.

9. Grain size has a definite effect on stress. The larger the grains are, the farther the region of maximum stress is moved away from the interface and into the deposit. A reason for this behavior has been proposed.

10. For similar type crystal structures, at least, lattice parameters definitely affect the formation of stress at the interfacial region. Nickel, which has a smaller lattice parameter than copper, is put down in tensile stress on copper, while the reverse is true when copper is plated on nickel.

11. The stress after-effect may be due to the formation of a concentration cell which causes some dissolution of metal and its redeposition but which, at the same time, releases some of the foreign matter at the grain boundaries so that the stress becames more tensile. Hydrogen does not appear to be the major cause of the stresses observed.

12. A theory for the cause of stress is suggested, based on the behavior of the water molecule in electroplating baths and/or the behaviour of trapped residues of coordination compounds or complex cations in the deposits.

Acknowledgement

The author acknowledges with deep appreciation the friendly guidance of *Prof. Allison Butts* in connection with this project. He is also indebted to *Carl Adelman* of Pocono Metal Products and his tool designer *Harry* for their help with some of the mechanical problems, to *Sidney Kushner* for laboratory assistance and to to *Dora Kushner* for proof reading the manuscript. The following organizations supplied some of the materials and chemicals used: International Nickel Co., Harshaw Chemical Co., Dow Chemical Co., General Chemical Co., Barrett Chemical Co.

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Science for the Coatings Technologist

Part X. Paint Additives — Anti-Settling Agents

By E. S. Beck

This installment concludes Part X of the series by Mr. Beck. The first half of this Part appeared in the June issue.—*Ed.*

Extenders

EXTENDERS on occasion are of great value in helping with pigment suspension. Talcs are perhaps the most useful in this connection. Fibrous talc is used as a suspending aid in zinc chromate primers and red lead paints. While it will not usually keep the pigments up completely, the sediment is much softer and easier to re-incorporate than in those cases when no talc is present. Many other extenders show this property to varying degrees. On the other hand, some high gravity extenders, such as barytes or blanc fixe, settle badly. So it cannot be assumed that all extenders are automatically suspending agents.

Another type of extender which frequently shows good suspending properties is the micronized form of magnesium silicate. Some types of this material are extremely fine, soft, easily ground, and have very little effect on the gloss of the finish. They can even be used in high gloss enamels in amounts up to 10 or even 20 per cent of the total pigment in many cases. The suspending power is fairly good; and, of equal importance is the fact that the precipitated pigment is soft in character and easily mixed back in.

Certain colloidal calcium carbonate pigments are valuable as anti-settling agents. These are extremely finely subdivided materials. They frequently produce a colloidal thickening of the coating, and this may account in part for the suspending action of the materials. In addition, they are anti-silking and anti-flooding agents, and will be considered also under those headings.

Treated Clays

Treated clays are perhaps the most useful of current anti-settling agents. These are relatively new developments, but their outstanding properties have helped them to wide adoption in a rather short time.

In general, these new treated clays are derivatives of the material Montmorillonite. This is a type of clay with a platey structure, a very small particle size, and an ability to swell in water. The clay is modified by the incorporation of organic radicals into its structure. This is done by means of reacting the clay with organic amines to produce a product with good organophilic properties.

The amine-treated clays are cream-colored, fine powders which are offered in a number of varieties, depending upon how they react with polar solvents. There are three general types now offered: two for non-polar solvents (hydrocarbons, such as xylol or mineral spirits); and one for polar solvents (alcohols, ketones, esters). One of the clays for non-polar solvents is higher in gelling efficiency. The latter is the newest of the clays and is not yet as well-established as the earlier materials.

The treated clays work well in extremely small amounts. From two to ten pounds per hundred gallons is the normal operating range. This corresponds to about 1 to 5 per cent on the dry pigment basis.

These clay derivatives show a moderate flatting tendency. For this reason (in addition to cost) it is desirable to use as little as required to get the desired effect. Proper selection of the grade is important here, as the use of the correct type of treated clay will give better gelling and suspending properties.

Proper method of incorporation is also important. These materials are not particularly difficult to incorporate. They may be ground in with the other pigments in the formulation, on either the roller mill or the pebble mill. If the coating contains essentially non-polar solvents, a small amount of polar solvent (such as methyl alcohol) may be added to improve the efficiency of the treated clay. The amount of polar solvent is generally set at 20-50% of the weight of treated clay. It should be added to the treated clay before the other solvents to get maximum activity.

The treated clays may also be pre-ground or pre-gelled in straight solvent. The appropriate amount of the gel can then be added, preferably to the pigment grind, if possible. A master batch can also be made by grinding the suspending aid in a portion of the liquid of the coating, and adding this to the finished product.

These materials show pronounced effects on the viscosity of paint systems. As pointed out above, they will gel the majority of solvents. Maximum suspending action depends upon obtaining the fullest possible development. Proper choice of grade of material to-

gether with best method of incorporation will yield maximum suspending properties with minimum viscosity increase.

The treated clays can sometimes be gelled by simple stirring under high speed agitators. For some applications, partial gelling in suitable solvents by simple hand stirring will be good enough to do the job. This is not generally recommended.

The treated clays can also be gelled by heat. Usually a temperature no higher than 150°F. is sufficient, with the appropriate solvent or solvent mixture.

Previously prepared gels or grinds are quite stable, and can be stored for considerable periods of time with no loss of properties. It is still the best practice to grind the gel in with the pigment during the preparation of the paint.

The anti-settling properties cannot always be utilized to their fullest extent. Frequently, in a given pigment and vehicle combination, one cannot obtain complete freedom from settling without producing at the same time a heavy thixotropic thickening of the paint. In such cases, it is necessary to reduce the amount of suspending agent until the viscosity effects are at a satisfactory level. Often, at this level, there will be some soft settling. But it is generally very soft, and easily redispersed.

The treated clays seem to have no effect on the adhesion or protective properties of the paint. The lack of undesirable side-reactions makes these materials quite valuable. All-in-all, they appear to represent the best general purposes, anti-settling agents available. For any given specific purpose, of course, some other material may show equal or superior properties. But nothing appears to be as good for so many different applications as is this class of materials.

A number of proprietary anti-settling agents are available for the paint formulator. It will not be possible to cover all of these; and indeed, the author has little knowledge of many of them. But there are some which are deserving of mention because of their valuable properties.

The composition of materials of this type is usually a more-or-less guarded secret. Though the composition of these additives has not been disclosed, they have been described as colloidal esters.

Both of these materials show extremely good anti-settling properties. They are also used as thickeners, anti-flooding agents, and flow control materials. As with almost all of the anti-settling agents, there is associated ability to produce a gel structure in the liquid phase of the coating, thereby reducing pigment mobility.

The first of the materials to be offered is designed for use in manufacturing where processing temperatures will not rise above 120°F., or fall below 90°F. In house paints, processing temperatures of as high as 150°F. can be tolerated.

Control of temperature is extremely important. If the temperature during grinding falls below 90°F., no increase in viscosity will be obtained, and little or no anti-settling properties will be manifested. This temperature range includes at least a part of the operating temperature range of a number of common mills, such as the roller mill, high speed stone mill, and, especially, the pebble and steel ball mills, which fall right in this range.

If the upper range of the temperature is exceeded, there is a possibility of the formation of graininess or actual seeds in the final coating. The permissible upper limit varies with the solvency characteristics of the solvent in the paint. As the solvency or the kauri butanol value rises, the permissible upper temperature drops. Thus, while with mineral spirits, it is possible to operate at a processing temperature of 120°F. with no ill affects, with toluol it is not safe to go above 90°F.

To overcome this weakness in the high temperature range, a second additive was later made available. It shows no tendency to graininess or seeding at any operating temperature. It produces best results in most systems when the processing temperature of at least 140°F. is attained during grinding. It works reasonably well at lower temperatures, but larger amounts of the material must be used to obtain equivalent results. Below 100°F., the efficiency falls off rapidly, and the previously described additive should be used.

These materials are used in small amounts, ranging from 2 to 10 pounds per hundred gallons. Optimum quantity frequently is in the vicinity of 4 pounds. It is generally desirable to use as little as possible because of the expense and the effect on the viscosity of the coating (where this is undesirable).

One additive is useful in suspending problems where viscosity must be kept within limits. An excellent example is the WP-1 wash primer. This material is made with a solvent entirely alcoholic. The government specification limits the upper range of the viscosity to a maximum of 67 KU. Pigment suspension is a definite problem in this material. Most of the ordinary suspending agents yield a final viscosity higher than 67 KU when present in amounts sufficient to suspend the pigment. This additive at 8 lbs. per hundred gallons gives adequate suspension at a final viscosity within the specification.

A third material is stated to be an anionic fatty alcohol sulfate compound. It is a clear, mobile liquid and is offered as operating in a different way than most other anti-settling aids. It does not work by means of swelling power, as do the majority of other such materials, but acts like a surface active agent. It coats the individual pigment particles, thereby procoats the individuals pigment particles, thereby providing an ionic electrical charge. It is this charge which keeps the pigment particles apart and increases the suspension. Observation confirms that it does not affect the viscosity of most paints to which it is added. The material is imported from West Germany, and is not yet widely available in this country.

It may be used in the grind, in the thindown, or by addition to the finished paint. This is a great advantage in an additive of this nature. While it is supposed to be somewhat more effective when added to the

grind, the author found little difference in results when the material was added at any stage, including the finished product.

It seems quite selective in its properties. In those formulations where it will reduce settling, it does so in fairly small amounts. In other formulas quite similar in composition, it may have no effect at all, even in substantial quantities. It is very definitely an additive which must be checked in the individual formula before adopting. In about half the formulas in which the author tried it, it showed little value; whereas in the balance of the coatings inspected, it was quite useful.

This third type additive is used in amounts ranging from 0.1% to 0.5% of the total weight of the paint. Because it is fairly expensive, the user will want to incorporate the smallest quantity which will do the job properly.

It is also useful as an anti-skinning agent, and will be mentioned when that class of materials are being considered.

LECITHIN

Soya lecithin, one of the most valuable paint additives, and a material in extremely wide use in the paint industry, is deserving of the designation as the material of a million uses. It is useful as a grinding aid, as a wetting agent, as an anti-flooding and anti-silking agent, as a viscosity control agent, as an anti-sagging agent, and as a very effective anti-settling agent.

The effect of soya lecithin on viscosity is rather minor. It seems to produce its suspending effect on pigments by bringing about a degree of flocculation. This flocculation, or agglutination, of the dispersed pigment particles produces a thixotropic rigidity in the coating, thus reducing settling by reducing mobility.

In this lies the principal weakness of soya lecithin as a suspending agent. Flocculation, by and large, is not desirable. The main object of the grinding operation is to break apart agglomerates. Anything which tends to recreate them, to some extent spoils the dispersion properties of the finished coating. This generally will show up as reduced flow properties and lowered gloss.

In many cases, a reduction in flow properties is unimportant, or even desirable. Brushing paints, for instance, cannot have much flow, or they will run or sag. Dipping enamels should not have excessive flow either, or they tend to pull away from sharp edges on the work.

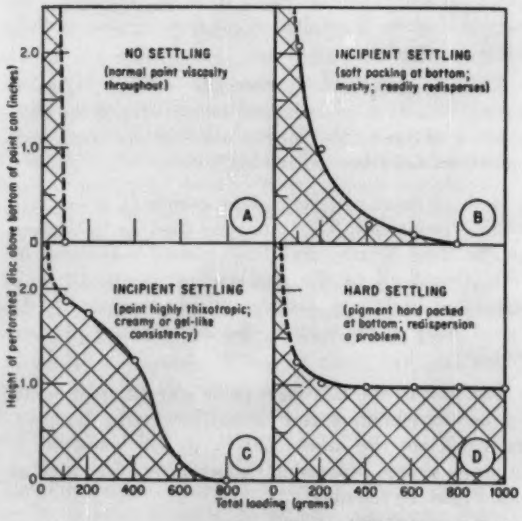
A dropping in gloss is another matter, however. In the case of soya lecithin, the drop in gloss in air dry products is almost always negligible. With baking products, there is often an objectionable loss of gloss, especially in the case of high gloss enamels. The effects in semi-gloss enamels are generally less pronounced. Often the method of application influences the gloss effects of lecithin very markedly. Dipping or flow-coating applications show this loss of gloss most emphatically.

A given baking enamel may show a high gloss when sprayed and a hazy flatness when poured or dipped, if it contains lecithin. This is a typical characteristic of a flocculated system. The work applied to the system by the mechanical action of the spraying or brushing process is often enough to overcome the flocculation temporarily, resulting in a high gloss. The dipping or flow coating process applies very little mechanical work to the paint, hence does little to overcome flocculation, even for a short time.

This action on the gloss is unpredictable. It appears in one formulation and not another. It frequently occurs one time in a given paint, and not another; even though all conditions are seemingly the same. It can be very marked, or only slightly noticeable. As an example of this variability, an article on soya lecithin appeared not long ago, wherein it was stated that in white baking enamels no loss in gloss was sustained. This was undoubtedly due to the particular formulation, or to the fact that all tests were on sprayed panels. In formulating laboratories, soya lecithin is almost never used in white baking enamels just because of its effect on gloss. The author once participated in some cooperative research with a soya lecithin producer to see if the method of production or purification of the material could be altered to reduce the gloss effect. No success was obtained with a variety of experimental grades. This led to the provisional conclusion that the hazing action was a built-in property of the lecithin itself; and not the result of impurities or of the processing procedure.

As a suspending agent, from ½ to 2 per cent of lecithin by wieght of the pigment is commonly used. It is best added to the grinding mix. In this way, the improved wetting and dispersing properties imparted by the lecithin are utilized. The suspending efficiency of the material is also somewhat improved when it is included in the grind.

However, lecithin frequently works very well when added to the finished paint. It is generally advisable in such cases, to thin it somewhat with the same solvents which are present in the coating before adding.



(Courtesy Baker Castor Oil Co.)

Fig. 4. Some Typical Pigment-Settling Curves. These curves tell the exact settling condition of the paint, much more thoroughly than could verbal descriptions.

In a formulation where lecithin works well, the suspending properties often go to the point where there is no settling at all, even over extended periods of time. In those cases where some settling still occurs, it is often in the form of a soft, semi-fluid character, extremely easy to redisperse.

The chemical nature of lecithin is interesting to consider shortly. It is a glyceride, in which one of the hydroxyls is esterified with choline phosphoric acid, and the other two hydroxyl groups with fatty acids. This produces a molecule which is polar at one end (the choline phosphoric acid) and non-polar at the fatty acid end. Such molecules, as is well known, will orient themselves in systems where polar and non-polar components are suspended, one in the other. In the case of this typical paint, the pigment is polar and the vehicle non-polar. The polar portion of the lecithin molecule orients toward the pigment particle and the non-polar part of the lecithin molecule is attracted to the solvent. In this way, the pigment particles are to a good extent coated or surrounded with lecithin. This provides a substantial portion of the protection against hard settling, as well as the wetting effect of the lecithin.

This concludes the consideration of anti-settling agents. But before proceeding to the next category of materials, it will be of interest at this point to look into a newly developed method of measuring and rating settling scientifically. This process was worked out by the laboratories a prominent paint additive producer.

The principle of the measuring process is to apply varying pressure on a perforated disc suspended in the paint. As the disc is forced down, it finally touches the bottom of the can or comes to rest on the settlement. If the maximum weight, when applied, does not push the disc through the settlement, it is considered to be hard and caked.

The time is also measured, so that the load on the disc can be increased in a standard and uniform manner. The disc is on the end of a calibrated plunger, and a plot is made of the distance of the disc from the bottom of the container versus the weight applied. This supplies a curve which gives a useful representation of the settling characteristics of the paint under test.

The data obtained in this way give a numerical expression of the depth of the settling and also of its hardness. This makes it possible to compare two or more coatings scientifically with a reasonable degree of precision. It should do away with such approximations as "small hard sediment" or "large, soft sediment." These terms give some idea of the nature of the settling, it is true, but are not precise enough in many cases for the comparison of materials in an accurate manner.

The profile of the coating which is obtained by this charting method can be used to make a permanent record of the characteristics of the material. It is advisable to run the test after a specified aging time, such as a month. The paint can be retested at intervals, and the charts compared. In this way, the progress of the settling can be followed and evaluated with precision.

Acknowledgement

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FACTORS AFFECTING STRESS

(*Continued from page* 55)

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A.E.S. Meets In Cincinnati

Three Associations Elect Officers and Plan Future Meetings

AT the 45th Annual Convention of the *American Electroplaters' Society*, held in Cincinnati May 19-22, *Dr. William Blum* was awarded the Society's recently created highest honor, the *AES Scientific Achievement Award*, and *Herberth E. Head* of Chrysler Corporation was installed as national president. The AES officially registered 1,002, but this was supplemented by those attending the *National Association of Metal Finishers* Convention which took place concurrently, and others who dropped in. *Charlie Wise* of Buckeye Products was the general chairman and *Ezra A. Blount* of Products Finishing, co-chairman.

At the business session, *Chester G. Borlet*, technical director of the Grand Rapids Brass Company and an active participant in branch and national AES affairs, was elected third vice-president. Mr. Borlet is also active in *the Electrochemical Society* and the *ASTM B-8 Committee*.

The *Metal Finishing Suppliers' Association* elected *Earl W. Couch* of The Lea Mfg. Co. as president and moved other officers up as follows: to first vice-president — *R. F. Ledford*, Industrial Filter and Pump Mfg. Co.; to second vice-president — *Fred P. Green*, Crown Rheostat & Supply Co. The new third vice-president is *J. G. Carrique* of Alloycraft Ltd., Montreal, Canada. *Thomas A. Trumbour* of METAL FINISHING continues as treasurer and *A. P. Munning* of Munning & Munning, as executive secretary. Trustees elected for two-year terms include *L. H. Davies*, Davies Supply & Mfg. Co.; *A. B. Hoefer*, Frederic B. Stevens, Inc.; and *R. M. Norton*, Hanson-Van Winkle-Munning Co.; and for one year, *S. M. Goble*, American Smelting & Refining Co.; *C. C. Helmle*, Enthone, Inc.; and *H. D. McLeese*, Metal & Thermit Corp.

The National Association of Metal Finishers selected *George W. Taylor* of Production Plating Company, Adel, Georgia, as their president. NAMF is the contract platers organization. Mr. Taylor is also active in the AES as a member of their public relations committee and has held many offices in the Southeastern Branch (Atlanta). Elected to serve with president Taylor were the following: 1st vice-president, *A. T. Leonard*, Superior Plating, Inc., Minneapolis; 2nd vice-president, *Harold W. Baker*, Electro Galvanizing Co., Chicago, Ill.; secretary-treasurer, *Frank Kaiser*, Long Island Mechanical Plating Co., Woodside, L. I., N. Y.; assistant secretary-treasurer, *Sal Novelli*, Service Plating Co., Brooklyn, N. Y.; past president, *John Palik, Jr.*, National Plating Corporation, Cleveland, Ohio; directors: *Harold E. Coombes*, Crown City Plating Co., El Monte, Calif.; *Ernest D. Callahan*, F. M. Callahan and Son, Malden, Mass.; *Amos Judd*, Amos Judd and Sons, Baltimore, Md.; *Curtis M. Varland*, Varland Metal Service, Inc., Cincinnati, Ohio; *John T. Hyduke*, Durable Plating Co., Cleveland, Ohio; *Lawrence J. Hay*, Plating Service Co., Chicago, Ill.; *Philip J. Ritzenthaler*, Production Engineering Co., West Allis, Wis.; *Henry J. Siegel*, Siegel-Robert Plating Co., St. Louis, Mo.; *Charles N. Leva*, Levco Metal Finishers, Inc., Long Island City, N. Y.; *Edward N. Marlette*, Marlette Plating Co., Buffalo, N. Y.; *Webster*

Herberth E. Head, new supreme president of the American Electroplaters' Society.

Earl W. Couch, new president of the Metal Finishing Suppliers' Association.

George W. Taylor, new president of the National Association of Metal Finishers.

Chester G. Borlet, newly elected third vice-president of American Electroplaters' Society.

J. G. Carrique, new third vice-president of the M.F.S.A.

Thomas A. Trumbour, general manager of Metal Finishing, being congratulated on his 75th birthday by M. M. Beckwith and A. P. Munning, officers of the M.F.S.A.

B. Knight, Knight Plating Co., Detroit, Mich.

The MFSA Board set some sort of a record for a meeting which lasted from 1:00 P.M. to 6:45 P.M. and came up with changes in by-laws, suggested plans for cooperating with the AES in future expositions, joint cocktail parties preceding annual branch banquets, plans for increasing membership and committee participation. All these proposals were reviewed for the general membership at the annual luncheon attended by 142. *Howard McAleer* of the Formax Mfg. Corp., Exposition Chairman for the 1959 Show in Detroit, spoke on the plans which are shaping up nicely. About 40% of the floor space has already been reserved by 175 firms who were exhibitors in previous Industrial Finishing expositions. This fact, together with Detroit being an active center of the finishing industry, the international aspects and 742 members of the *Detroit AES Branch* backing it up, indicate a large attendance.

The Exposition will be staged in the *Artillery Armory* some distance from the downtown hotels but bus service will be provided. The afternoon technical sessions will be held in the Armory and there will be two night sessions for the benefit of local executives. It will run 4 days, opening on Tuesday, June 15. The Armory is located at 15000 West Eight Mile Road in Oak Park. Space rentals run from $2.25 to $2.75 per square foot, which is less than the Cleveland show in 1955. Ample parking space will be provided, and good food by a prominent Detroit restaurant chain. As an attendance inducement there will be door prizes, probably automobiles. Mr. McAleer announced that a number of foreign manufacturers have contracted for exhibit space.

The AES has lined up branches to sponsor future national conventions and locations as follows:

1959 *Detroit Branch* — Hotel Statler, Detroit

1960 *Los Angeles Branch* — Hotel Statler, Los Angeles

1961 *Boston Branch* — Hotel Statler, Boston

1962 *Milwaukee Branch* — Hotel Schroeder, Milwaukee

1963 *Newark Branch* — Ambassador & Traymore Hotels, Atlantic City, N. J.

The 1959 interim meeting of delegates will be sponsored by the Southeastern Branch and held in Atlanta during February.

The MFSA Golf Tournament was played at the Kenwood Country Club under the direction of *Bob Burford,* chairman. Some 48 golfers took part, and the low gross was turned in by *Harold Marsh* of Hammond Plating, Ypsilanti, Michigan. Others who won prizes, in order of their success, were: *Jim Badaluco,* Hanson-Van Winkle-Munning Co.; *John Davidson,* Pennsalt Chemicals Corp.; *George Hay,* Products Finishing; *Dick Goebner,* Pennsalt Chemicals Corp.; *Ed Kubis,* Wyandotte Chemicals Corp.; *Chet Borlet,* Grand Rapids Brass; *W. Karash,* The Harshaw Chemical Company; and *Roger Winterman,* Globe Chemical Company.

The Story of William Blum

Dr. William Blum was born in Philadelphia on December 28, 1881, and was educated in the public schools of Philadelphia. When he graduated from the Central High School, he received a scholarship to the University of Pennsylvania where he studied chemistry under *Dr. Edgar Fahs Smith,* who was one of the earliest Honorary Members of the A.E.S. In his senior year, Dr. Blum studied electro-analysis which initiated his interest in electrochemistry.

From 1903 to 1909, he taught chemistry at the University of Utah where he came into close contact with the copper and lead mines and smelters. In connection with studies on smelter smoke pollution, he frequently climbed 250-foot smelter stacks to sample the discharged gases. (This was the greatest height he attained until in later years he became addicted to flying in airplanes.)

During the summer vacations and the academic year of 1907-1908, he was a graduate student at the University of Pennsylvania where he received his Ph.D. in 1908.

In 1909, he became a chemist at the *National Bureau of Standards* (NBS) in Washington, D. C., where he engaged in analytical researches under *Dr. W. F. Hillebrand,* a world-famous analytical chemist. In 1913, he was assigned to investigate the cause of certain difficulties encountered in the copper electrotyping baths at the U. S. Government Printing Office. During the next few years, he studied the factors involved in the operation of these baths and published the results in N.B.S. Circular 52.

The close similarity between electrotyping and electroplating led him to

Dr. William Blum receiving the A.E.S. Scientific Achievement Award.

The M.F.S.A. Board pauses for a picture during their 6½ hour meeting.

Speakers' table at the annual M.F.S.A. luncheon.

Chow line at the M.F.S.A. "Open House."

The N.A.M.F. Board meeting.

One of the ladies' functions.

Busses take the platers to Coney Island.

M.F.S.A. "Open House" was a lively affair.

Platers from all over check in for the Sunday night reception and get-together.

attend, in 1915 in Dayton, Ohio, the Convention of the American Electroplaters' Society (AES) which he then joined and with which he has since been so closely associated. He has missed only one AES Convention since 1915. (The only individual who has never missed an A.E.S. convention is our own *Thomas A. Trumbour.*)

During World War I, to meet the needs of military agencies on electroplating problems, three experienced electroplaters, all members of the AES were added to the staff of the N.B.S. Electroplating Section viz: *Fred J. (Dad) Liscomb; Thomas F. Slattery* and *George B. Hogaboom.* The latter association led to the joint preparation in 1924 of the first edition of *"Blum and Hogaboom,"* a title more often used than *"Principles of Electroplating and Electroforming."* This book was revised in 1930 and again in 1949.

During the interval from 1913 to 1951 when he retired, Dr. Blum directed the work of the N.B.S. Electrodeposition Section, in which a total of over 100 men and women have been employed. Many of these persons continued their interest in electrodeposition after they left the Bureau to accept industrial positions. Over 100 technical papers on plating were published by the group, chiefly in *"Monthly Review"* of the AES (now *Plating*); the *Transaction of the Electrochemical Society, Metal Finishing* and the *Journal of Research of the National Bureau of Standards.*

Dr. Blum has been richly rewarded by numerous honors in recognition of his scientific activities. The AES made him an Honorary Member in Philadelphia in 1919, partly in recognition of three papers presented there on wartime studies in which Liscomb, Slattery and Hogaboom cooperated. In 1928, the AES presented him with a gold watch, which he uses regularly and cherishes highly. He is also an Honorary Member of the AES Research Committee in which he still takes an active part.

He is an Honorary Member of *The Electrochemical Society,* of which he was President in 1926. In 1944, this Society presented him with the *Acheson Medal.*

The *Institute of Metal Finishing* (formerly the *Electrodepositors' Technical Society*) conferred Honorary Membership upon him, and he presented the *Hothersall Memorial Lecture* and received the *Hothersall Medal* in London in April, 1954.

He has taken an active part in the work of Committee B-8 of the A.S.T.M. In the preparation of specifications for electroplated coatings. In 1951, the A.S.T.M. gave him an "Award of Merit."

The University of Pennsylvania conferred the honorary degree of Doctor of Science upon him in 1953, and the Franklin Institute of Philadelphia awarded him the Elliott Cresson Medal in 1953.

The Gibson lobby was always a busy place.

In 1926, the American Institute of Chemists awarded their first medal to him for *"Distinguished Governmental Service."* In 1951, the U. S. Department of Commerce presented him with a medal for *"Outstanding Contributions to Science."*

During both World War I and II, and since the latter conflict, he has served as an advisor to the War and Navy Departments and, since 1951, he has been a part-time consultant to Frankford Arsenal in Philadelphia and Rock Island Arsenal in Illinois. In 1951 Frankford Arsenal made a special unique award to him for his service in this capacity.

In 1953, the *American Chemical Society* awarded him a certificate for 50 years membership and made him an *"Emeritus Member."*

Dr. Blum has become well acquainted in the field of electrodeposition in other coutnries. In 1935, he presented a paper to the *Faraday Society* in London and visited many plants and laboratories in England, France, Germany and Holland. In 1953, he spent four months on a trip to Australia and New Zealand, where he gave over 25 lectures on plating and related subjects to AES Branches and to other scientific societies, and visited many plants and laboratories. In 1954, Mrs. Blum and he spent three months in England and the Continent after the International Conference on Electrodeposition and Metal Finishing in London in April.

Acknowledgement

The photos in this article were furnished us through the courtesy of the H-VW-M Official Convention News, published daily during the convention by the Hanson-Van Winkle-Munning Co.

Another view of the speakers' table at the M.F.S.A. annual luncheon.

FINISHING POINTERS

Design of a Plating Line

By J. B. Mohler

PLATING rack design is based on space limitations of the tanks that will receive the rack. This obvious fact is the basis for the construction of racks to be used to process new work. Conversely, the dimensions of a plating rack determine the size of a plating tank. The plating rack is the yardstick for the design of a plating line. Fixed tank requirements can easily be determined by the use of this yardstick. Two pieces of information are essential to apply this means of measurement. First; the number and size of the pieces to be plated. Second; the plating cycle.

Let us assume, for example, that we are to plate 2,000 polished steel drawer pulls per hour with 0.4 mil nickel and 0.02 mil chromium according to the cycle:

1. Anodic clean one minute.
2. Cold rinse.
3. Acid dip 30 seconds.
4. Cold rinse.
5. Nickel plate 14 minutes, 40 amp./sq. ft.
6. Cold rinse.
7. Chromium plate 4 minutes, 100 amp./sq. ft.
8. Cold rinse.
9. Hot rinse.
10. Dry.

Rack Dimensions:

Drawer pulls — 1" diam. x 1" long
spacing between pulls on rack ——— 1"
tank depth (nominal) ——— 36"
solution level ——— 33"
rack distance above bottom of tank —— 6"
rack distance below solution level ——— 3"
rack height = 33 — 6 — 3 = 24"
rack width (nominal) = 18"

Work is placed on 2" centers; therefore, rack capacity $= \frac{18}{2} \times \frac{24}{2} = 108$ pieces. Use both sides of rack or $108 \times 2 = 216$ pcs./rack.

Allow ½" for rack support thickness and 1" rack to work distance: then rack and work thickness loaded $= 1 \times 2 + 1 \times 2 + \frac{1}{2} = 4\frac{1}{2}$".

Tank Dimensions

Nickel Tank:

2000 pcs./hr., 216 pcs./rack and 14 min. plating time.

$\frac{60}{14} \times 216 = 925$ pcs./rack/hr.

$\frac{2000}{926} = 2.16$ racks

Space for three racks will allow for transfer time. Allow 6 inches between racks, 6 inches rack to end of tank distance and 12 inches space for heaters. Tank length $= 6 \times 2 + 6 + 18 \times 3 + 12 = 84$". Allow 6 inches rack to anode distance, 2 inches for anodes and 3 inches anode to tank distance. Tank width = 4½ (rack) $+ 6 \times 2 + 2 \times 2 + 3 \times 2 = 26\frac{1}{2}$".

Chromium Tank:

One rack per tank with same allowances as for nickel tank:

Length $= 6 + 18 + 12 = 36$".
Width = same as nickel tank = 26½".

Rinse Tanks:

Allow 3 inches rack to tank distance.
Length $= 2 \times 3 + 18 = 24$"
Width $= 2 \times 3 + 4\frac{1}{2} = 10\frac{1}{2}$".

This example readily demonstrates the use of rack dimensions as a yardstick to design a plating line. A layout can be drawn after all the tank dimensions are established. The layout will define floor space. Ventilation, heating, sewers, and space for storage can be estimated from the layout of the line.

Note that, if work is placed only on one side of the rack, the size of the nickel tank will be much larger. Thus, a detail in efficiency of rack design can make a big difference in the size of the plating tank. Consider also that the racks can be placed across the width of the tank with anodes between or that three rows of anodes can be used with two rows of racks placed parallel to the long dimension of the tank. If the racks are small the plater can handle two at a time. With double handles a plater can manage a longer rack (but consider the weight of the rack plus the work). If a large rack is used, larger rinse tanks will be required.

After the layout is complete, one can estimate the cost for installation of a line. The required labor can also be estimated from the layout. This general procedure has been used as a means of estimating prospective plating costs. A comparison with quotations from a local job shop may show that production will not be on a sufficient scale to warrant an installation. This is often the case for plating of a limited number of parts. For large volume production the answer should be the reverse. The same general method is used to determine if hand plating is more economical than automatic plating. Suppliers of automatic equipment will give figures on the racks per hour that can be processed. Again the rack is the starting point.

The design of a rack and placing of the work on the rack must be visualized. Work must be as close as allowable. Economy of space is essential but the principles that govern work placement must be considered to avoid the false economy of crowding. The parts must not rob one another or shadow other parts. Some work can be placed within a fraction of an inch while other work requires generous spacing. A guess can be made for spacing but it should not be a pure guess. If there is a reasonable doubt, a rack should be constructed and work should be plated as a means to determine the most economical design. This is not an uncommon practice. The capacity and design of the rack must be known in order to estimate all that follows. One must have the proper measuring stick.

PHOSPHATING TREATMENTS*

A COMPREHENSIVE PATENT LITERATURE SURVEY

PART IV

By Ervin C. Tinsley**

286. *Proofing of Iron and Steel Against Rust.* By W. H. Cole. U. S. 1,719,464. July 2, 1929.

Same as Brit. 289,906 & U. S. 1,719,463 plus potassium chromate, and ammonium phosphate.

287. *Rust Proofing Iron.* By W. H. Allen (Parker Rust Proof Co.). U. S. 1,735,842. September 19, 1929.

The objects are immersed into a sol. containing acid phosphates of chrome and then subjected to heat to transform the chrome phosphate into pyrophosphate.

288. *Coated Iron and Steel Articles and Method of Making the Same.* By Elmer M. Jones (Parker Rust Proof Co.). U. S. 1,750,270. March 11, 1930.

The parts are immersed into a boiling solution of phosphoric acid and colloidal silicic acid.

289. *Process of Producing a Phosphate Coating on Metal.* By Matthew Green and Van M. Darsey (Parker Rust Proof Co.). U. S. 1,755,391. April 22, 1930.

Suggests the use of two baths (new and aged) so that the desired amount of coating can be attained. The parts to be processed are placed into the new bath for a part of the time. Removed and placed in the aged bath for the remainder of the processing time.

290. *Process of Treating Ferrous Metal Articles.* By M. C. Baker and W. A. Dingman (Parker Rust Proof Co.). U. S. 1,761,186. June 3, 1930.

The treatment period of the Coslett process (U. S. Patent 870,937) is shortened by heating the degreased metal articles to 500-550°F, plunging them into a bath of 33-1/3% orthophosphoric acid for 1-2 minutes and heating them again to 325 to 450°F.

291. *Surface Protection for Magnesium Alloys.* By Russell E. Lowe (Doherty Research Co.). U. S. 1,765,341. June 17, 1930.

A method of providing magnesium alloy with a protective coating comprising initially dipping said alloys in a mild cleaning solution of nitric acid, washing, immersing said alloy in a 5% solution of phosphoric acid long enough to allow a film to form thereon, and finally immersing it in a 5% solution of ammonium phosphate for a period of two to five days.

292. *Manufacture of High-Acid Phosphates of Iron.* By Matthew Green and E. Jones (Parker Rust Proof Co.). U. S. 1,769,057. July 1, 1930.

Iron filings are put into an inclined barrel into which 65% phosphoric acid is injected. The temperature is held at about 100°C. The ferrous hyper phosphate that is formed when applied in the preparation of phosphate solutions leads to the formation of coatings which are slightly corrosion resistant.

293. *Preparation of Steel for Painting.* By J. H. Gravell (American Chemical Paint Co.). U. S. 1,781,507. November 11, 1930.

The pieces are degreased with caustic soda, and then dipped into a solution of dilute phosphoric acid, then washed with a 5% disodium phosphate solution.

294. *Composition for Treating Iron to Prevent Rusting.* By E. H. Wallace (Rust Prevention Chemical Co.). U. S. 1,790,960. February 3, 1931.

The parts are immersed in a solution composed of 42.5% H_3PO_4, 56% water, and 1.5% casein.

295. *Coating Metal.* By Van M. Darsey (Parker Rust Proof Co.). U. S. 1,791,715. February 10, 1931.

After phosphate treatment the parts are immersed into a hot solution of a salty chromic acid.

296. *Method of and Material for Preventing Metal from Corroding.* By James H. Gravell (American Chemical Paint Co.). U. S. 1,805,982. May 19, 1931.

The parts are treated, before the coating, with a mixture of organic phosphates and acid phosphates of iron and resin. It is then immersed into a solution composed of dianiline phosphate, iron oxide, kerosene, stearine pitch, and gilsonite.

297. *Proofing of Metal Against Corrosion and Particularly Iron and Steel Against Rust.* By William H. Cole. U. S. 1,826,866. October 13, 1931.

A better phosphate coating is obtained if the parts are first immersed in a solution of 12° Be phosphoric acid. The proofing solution consists of 1 liter 12° Be phosphoric acid, 50 grams iron, 60 grams zinc; 10 grams aluminum and 10 grams chromium.

298. *Preparation of Steel for Painting.* By J. H. Gravell (American Chemical Paint Co.). U. S. 1,837,430. December 22, 1931.

On the surface, a solution of ethyl alcohol, butyl alcohol and H_3PO_4 is sprayed and without washing, the parts are heated to 120°C.

299. *Rust Proofing and Method of Making the Same.* By Matthew Green and Elmer M. Jones (Parker Rust Proof Co.). U. S. 1,842,085. January 19, 1932.

The method of mixing iron fragments with phosphoric acid until the mixture becomes stiffly plastic, and then adding MnO_2 until a powdering condition is reached.

300. *Rust Proofing Iron and Steel Articles.* By W. M. Phillips and G. M. Cole (General Motors Corp.). U. S. 1,856,261. May 3, 1932.

The parts to be treated are connected with the cathode and immersed into a boiling solution composed of zinc diphosphate containing small amount of free phosphoric acid.

301. *Preparation of Surfaces for Coating.* By Elmer M. Jones (Parker Rust Proof Co.). U. S. 1,860,505. May 31, 1932.

The method which consists in electrolytically depositing a coating of iron upon the surface of an article and then treating the iron thus deposited with a solution of phosphates until a coating of insoluble phosphates is formed upon the surface of articles.

302. *Rustproofing Material and Method of Treating the Same.* By Van M. Darsey (Parker Rust Proof Co.). U. S. 1,866,879. July 12, 1932.

Finds that rustproofing materials consisting of high acid phosphates of metals of the electromotive series from manganese to iron, inclusive, exist primarily to granular or pulverulent form is soluble and reactive. If this material is allowed to dry out, it first loses moisture and subsequently reabsorbs moisture, changing hereby into crystal form. It then has the tendency of caking together. To avoid this, the inventor adds 1-3% boracic acid. Possible substitutes are sugar and zinc carbonate.

303. *Method and Material for Coating Metal Surfaces.* By John S. Thompson and Robert R. Tanner (Parker Rust Proof Co.). U. S. 1,869,121. July 26, 1932.

The method of coating the surfaces with a solution of the acid of phosphates with copper as a constituent. The free to total acid ratio maintained between 6 to 1 and 15 to 1, and the 2-4/1000ths of 1% of copper. "The Spray Bonderizing Process."

304. *Process of Cleaning Metal.* By Harry G. Mangey (General Motors Research Corp.). U. S. 1,872,091. August 16, 1932.

The parts to be processed are immersed into an alkali metal cleaner to remove scale and rust and finally immersed into a dilute solution of H_3PO_4. This forms a thin phosphate coating on the part and prepares it for further processing.

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*The opinions or assertions contained herein are not to be construed as being official or reflecting views of the Department of the Army.

**Ordnance Corps, Metal Finishing Laboratory, Rock Island Arsenal, Rock Island, Ill.

305. *Coated Iron or Steel Article and Method of Making the Same.* By Robert R. Tanner (Parker Rust Proof Co.). U. S. 1,873,363. August 23, 1932.

The articles are treated in a hot, dilute solution of phosphoric acid and cupric oxide. They are then removed and heated to oxidize the metallic copper and remove galvanic action.

306. *Composition for Coating Metals and Method of Making the Same.* By R. R. Tanner & Van M. Darsey (Parker Rust Proof Co.). U. S. 1,887,967. November 15, 1932.

Replenishing mixture for phosphating baths composed of manganous di-hydrogen ortho-phosphate and copper oxide.

307. *Coated Metal Article and Method of and Composition for Producing Said Article.* By Robert R. Tanner and Van M. Darsey (Parker Rust Proof Co.). U. S. 1,888,189. November 15, 1932.

Parker's "Bonderite" process. Definite control on free and total acid necessary to produce an ideal coating. Small quantities of copper salts must be added.

308. *Process for Making Coating Materials for Deoxidation of Rust.* By Rudolf Eberhard. U. S. 1,893,495. January 10, 1933.

The parts are immersed into a sol. containing tungstic anhydride, caustic potash, phosphomolybic acid.

309. *Material for and Process of Coating Metal.* By James H. Gravell (American Chemical Paint Co.). U. S. 1,895,320. January 24, 1933.

The parts are pre-treated with an admixture comprising kerosene, stearin pitch, and orthophosphoric acid.

310. *Production of Protective Coatings in Iron and Steel Articles.* By Leo P. Curtin, Bernard Kline (Western Union Telegraph). U. S. 1,895,569. January 31, 1933.

The parts are treated in a solution containing ferric oxalate, oxalic acid, acetic acid, and sulfuric acid, and phosphoric acid.

311. *Coated Iron or Steel Article and Method of Making the Same.* By Edward J. P. Fishers & Clyde C. Crane (Keystone Steel and Wire Co.). U. S. 1,910,385. May 23, 1933.

The steel wire is treated at an elevated temperature in an atmosphere of phosphine (PH_3), gas, and then zinc coated by the hot-dip galvanizing process.

312. *Coating Metal With An Organic Salt of the Metal.* By Robert R. Tanner (Metal Finishing Research Corp.). U. S. 1,911,537. May 30, 1933.

The parts are treated in a solution which contains as the major portion, acid of the group of dicarboxylic and the hydroxydicarboxylic acids of the aliphatic series plus sodium sulphite and manganese dioxide.

313. *Production of Phosphate Coatings on Metals.* By Robert R. Tanner and Herman J. Lodeesen (Metal Finishing Research Corp.). U. S. 1,911,726. May 30, 1933.

A dry particle material for replenishing a phosphate bath comprising 242 pounds of di-hydrogen phosphate of zinc and manganese nitrate. The particles are coated with 5 pounds of calcium carbonate.

314. *Process and Product for Protecting Aluminum, Magnesium, Zinc and Their Alloys Against Corrosion.* By Pierre Prier. U. S. 1,923,502. August 22, 1933.

The parts are immersed into an aqueous solution consisting of phospho-chromate and sulphomolybdate of an alkali metal; and 1.5% tartrate of sodium, and 0.5% orthophosphate of an alkali metal. (Such as trisodium phosphate.)

315. *Coating Metal With Zinc Phosphate.* By Van M. Darsey (Metal Finishing Research Corp.). U. S. 1,926,265. September 12, 1933.

A method of coating surfaces of metal in the group consisting of iron, zinc magnesium and their alloys, which consists in forming a solution containing acid phosphates of metal in the group consisting of zinc, manganese and iron and a cyanide compound and subjecting the surface to be coated to the action of the solution.

316. *Coating Compositions.* By Herbert O. Albrecht (E. I. du Pont de Nemours). U. S. 1,936,534. September 21, 1933.

A coating composition comprising a drying oil, and a hydrocarbon solvent solution of a phosphate of a triethanolamine ester of an organic acid, said acid being selected from the class consisting of fatty and resin acids.

317. *Surface Treatment of Magnesium and Magnesium Base Alloys.* By Edward C. Burdick and William H. Gross (The Dow Chemical Co.). U. S. 1,947,122. January 13, 1934.

The parts are immersed into a near boiling solution of 10% sodium di-hydrogen phosphate plus sodium dichromate.

318. *Coating Metals Such as Magnesium, Zinc, Iron, and Their Alloys.* By R. R. Tanner and H. J. Lodeesen (Metal Research Corp.). U. S. 1,949,090. February 27, 1934.

The bath consists of acid phosphates of the metals with quantities of copper nitrate and oxidizing agents other than nitrates. The phosphate and nitrate are in proportion of approximately 5-1.

319. *Cleaning and Protecting Metals Against Rusting.* By William K. Schweitzer (Grasselli Chemical Co.). U. S. 1,949,921. March 6, 1934.

Parts are treated in a cleaning and derusting solution consisting of 1 vol. 85% phosphoric acid, 1 vol. iso-propyl ether, 1½ vol. of water, 1 vol. of denatured alcohol.

320. *Process for Protecting Magnesium and its Alloys Against Corrosion.* By Guy D. Bengough and Lawrence Whitby (Imperial Trust for the Encouragement of Scientific and Industrial Research). U. S. 1,961,030. May 29, 1934.

A process of protecting magnesium and its alloys against corrosion which consists in treating the metal with an aqueous solution of soluble selenite containing a material selected from the group consisting of phosphoric acid and selenous acid.

321. *Finish and Method of Producing Same.* By Charles M. Andre (Otis Elevator Co.). U. S. 1,973,740. November 13, 1934.

The parts are prepared for protection by processing the parts by the "Parkerizing" method. The phosphated parts are dyed by a lacquer and baked.

322. *Material for Coating Metal.* By James H. Gravell (American Chem. Paint Co.). U. S. 1,980,518. November 13, 1934.

Steel, iron or zinc are treated with a solution consisting of 30 lbs. Fullers earth, 5 lbs. monocalcium phosphate, 0.5 lbs. cupric nitrate, 2.4 lbs. butyl alcohol, and 6.32 gals. of water.

323. *Metal Cleaning and Rust Preventing Solution.* By K. Schweitzer (Grasselli Chemical Co.). U. S. 1,992,045. March 19, 1935.

The solution substantially consists of H_3PO_4 to which 1 to 5% by weight of sulphonate is added.

324. *Method and Material for Producing Phosphate Coating.* By John S. Thompson and Van M. Darsey (Metal Finishing Research Corp.). U. S. 2,001,754. May 21, 1935.

A process of coating iron or steel which consists in forming a solution containing acid phosphates and a nitrate of an alkali metal, immersing in the solution articles having surfaces of iron or steel and maintaining the strength of the solution by adding thereto acid phosphates and a nitrate of an element of the class that consists of magnesium, calcium, barium, strontium, manganese, zinc, cadmium and iron, which enter into the coating as bases of phosphates.

325. *Material for Providing Metal With a Paint Receptive Surface.* By James H. Gravell (American Chemical Paint Co.). U. S. 2,005,780. June 25, 1935.

A material to make a receptive surface consists of clay, mono-calcium phosphate, and water. This is painted on and allowed to dry at varying temperatures up to 200°F.

326. *Rust Proofing Composition and Method of Coating Iron and Steel.* By Guy A. McDonald (Victor Chemical Works). U. S. 2,030,601. February 11, 1936.

The solution consists of 10-25% phosphoric acid and chromate or a ratio of .25 sodium dichromate to 1 part phosphoric acid.

327. *Corrosion Resisting Coating.* By Carl E. Heussner (Chrysler Corporation). U. S. 2,041,545. May 19, 1936.

Zinc or zinc die cast articles are treated with a solution composed of barium nitrate 15 grams, aluminum hydrate 10 grams; phosphoric acid, 14 grams; water 1 liter. Processing time is 5-15 minutes at 200°F temperature.

328. *Method of and Material for Coating Metal Surfaces.* By Robert R. Tanner and Herman J. Lodeesen (Metal Finishing Research Corp.). U. S. 2,045,499. June 23, 1936.

The object of this invention is to provide a material which can be premixed and transported and stored without serious deterioration; and can be mixed in proper proportions and employed to form or replenish a phosphate coating solution as desired. One proportion that was found satisfactory was made up as follows:

Manganese dihydrogen phosphate 186 pounds, barium nitrate 42, manganese sulphate ($MnSO_4 \frac{1}{2} H_2O$) 22 pounds and copper sulphate or carbonate 6 oz.

329. ***Process for Hardening Iron and Steel Alloys and the Article Produced Thereby.*** **By Marie Louis Andre Babinet (Nitralloy Corp.). U. S. 2,057,813. October 20, 1936.**

An article of manufacture consisting of a normally passive corrosion-resisting ferrous base alloy and having smooth nitride hardened surface portions, said surface portions having been prepared by mechanically working them to the desired smoothness and shape, thereafter treating said surfaces with a compound containing the PO_4 radical and then nitriding.

330. ***Method of Coating Composite Articles.*** **By George J. Farnworth (Budd Wheel Co.). U. S. 2,059,783. November 3, 1936.**

The method of selectively coating one of the component elements of a composite structure comprising carbon-steel and stainless steel elements, which comprises subjecting the structure in an aqueous bath to a coating medium consisting of a phosphate of a metal and having substantially no tendency to form such a coating with the surface of the carbon steel.

331. ***Method of Coating Metal.*** **By Van M. Darsey (The Patents Corp.). U. S. 2,067,007. January 5, 1937.**

Parts are treated in solution composed of zinc acid pyrophosphate, ferrous sulphate, tartar, and water. It is operated at room temperature for 2 to 5 minutes.

332. ***Method of Coating Metal.*** **By Robert R. Tanner and John S. Thompson (The Patents Corp.) U. S. 2,067,214. January 12, 1937.**

To provide a better bond for paints, lacquers, varnish, etc., the parts may be processed with zinc phosphate, phosphoric acid, and nitric acid to provide the NO_3 radical which strengthens the bond of coating to a siccative coat.

333. ***Method of Bonding Siccative Coats to Metal.*** **By Robert R. Tanner and John S. Thompson (The Patents Corp.). U. S. 2,067,215. January 12, 1937.**

The phosphate articles after H_2O rinsing are dipped for 1 minute in a hot solution of 15 grams ferric (or chromic) nitrate: or 30 grams aluminum nitrate in 8 gallons water.

334. ***Method of Coating Metal.*** **By John S. Thompson and Herman J. Lodeesen (The Patents Corp.). U. S. 2,067,216. January 12, 1937.**

After phosphate treatment the parts are immersed into chromic acid rinse of the strength of 2 to 20 grams of CrO_3 per gallon at 200-205°F.

335. ***Metal Cleaning.*** **By George Lutz (E. I. du Pont de Nemours). U. S. 2,070,487. February 9, 1937.**

The parts are immersed into a 35% solution of phosphoric acid, then small amounts of either chromic acid, antimony, or aluminum are added.

336. ***Inhibiting Corrosion of Metals.*** **By Anthony F. Benning, Lawrence G. Benton and Richard G. Clarkson (E. I. du Pont de Nemours). U. S. 2,080,299. May 11, 1937.**

A rust proofing composition for metals comprising essentially 2 parts di-lauryl phosphate dissolved in 98 parts of light lubricating oil.

337. ***Method and Material for Coating Metal.*** **By Robert R. Tanner (Metal Finishing Corp.). U. S. 2,081,160. May 25, 1937.**

The parts are treated in a solution of butyl alcohol and copper or manganese nitrates dissolved in said alcohol.

338. ***Coating Zinc and the Coated Article.*** **By Matthew Green (Parker Rust Proof Co.). U. S. 2,082,950. June 8, 1937.**

A solution consisting of zinc dihydrogen phosphate and a soluble iron compound is employed. The iron content is 1/3 to ½ the zinc in solution.

339. ***Rustproofing Metal Articles.*** **By Robert H. Gordon (Parker Rust Proof Co.). U. S. 2,089,648. August 10, 1937.**

Articles to be rustproofed are sprayed with a rustproofing solution which reacts chemically with the metal to form a protective coating. Excess sprayed solution is collected in a tank through which it flows in a tortuous path permitting time for sedimentation of suspended matter, and the collected solution is then re-sprayed. The apparatus is described.

340. ***Protective Treatment of Metals and Alloys.*** **By Herbert T. Davies, London (The Metallurgical Treatment Syndicate Limited). U. S. 2,097,211. October 26, 1937.**

Before phosphating the parts are immersed in a dilute solution of copper, nickel, or zinc sulphate 1% at room temperature. Electric current is allowed to pass through the articles for a few minutes. Then the phosphoric acid or iron phosphate treatment is applied.

341. ***Noncorrodible Object and Method of Producing Same.*** **By Frank P. Romanoff (Apollo Metal Works). U. S. 2,103,119. December 21, 1937.**

This applies to electroplated parts from which the electroplated film has been removed due to punching, drilling, cutting, etc. The exposed area is rust proofed by immersion in manganese phosphate solution which does not attack the plated areas.

342. ***Mechanically Working Metal Article.*** **By Fritz Singer (Germany). (Tubus A. G. Zurich). U. S. 2,105,015. January 11, 1938.**

A phosphate coating is produced using phosphoric acid, proto-chloride of iron ($FeCl_2$), perchloride of iron, and mercury sublimate (Hg_2Cl_2), water, and a few drops of HCl. The parts are heated at 100°C for 30 minutes, treated with steam, and finally boiled in water.

343. ***Phosphated Metal Coating.*** **By Leo P. Curtin (Curtin-Howe Corp.). U. S. 2,120,212. January 10, 1936.**

Good coatings are made with an acid phosphate solution containing both zinc dihydrogen phosphate and manganese dihydrogen phosphate in a molecular ratio of about 2:1. Iron dihydrogen phosphate is present in amount equal to about 1% of the total phosphates. Hydrogen peroxide added to the bath in a concentration less than 0.1% has a depolarizing action and accelerates the formation of a coating.

344. ***Maintenance of Phosphate Coating Baths.*** **By Leo P. Curtin (Curtin-Howe Corp.). U. S. 2,121,520. June 21, 1938.**

By the use of sulfur dioxide in the phosphating bath, the acidity is maintained at an equivalent to that of a soluble dihydrogen phosphate and adapted to reduce the ferric iron to ferrous. To maintain the SO_2 content sodium bisulfite is added at the rate of 2.5 grams per liter.

345. ***Art of Coating Zinc.*** **By Gerald C. Romig (American Chemical Paint Co.). U. S. 2,121,574. June 21, 1938.**

Zinc coated galvanized steel is phosphatized in a solution composed of phosphoric acid (75%), zinc ions as major cation, plus nickel as minor ionic, and sodium nitrate. Ratio of zinc to nickel 100:2. Ratio of cations to nitrate 20:25.

346. ***Lithographic Printing Plate.*** **By Walter Strickland Field (England). (The Pyrene Co. Limited) U. S. 2,126,181. August 9, 1938.**

The plates are cleaned with butyl alcohol and then immersed in an etching solution of dilute nitric acid. They are then treated in a heated solution of zinc dihydrogen phosphate for 30 to 40 minutes.

347. ***Process of Applying Bonding Coating to Metal and Products Thereof.*** **By Leo P. Curtin (Curtin-Howe Corp.). U. S. 2,127,207. August 16, 1938.**

The parts are phosphated by any accepted process and then immersed into a .025 to .20% solution of copper sulfate pentahydrate for about 15 seconds at 25°C.

348. ***Phosphate Coating Bath and Method of Making.*** **By Leo P. Curtin (Curtin-Howe Corp.). U. S. 2,132,000. October 4, 1938.**

The bath should consist of 1 molecule of dihydrogen phosphate, 1 molecule of manganous sulfate, and 0.25 molecule of zinc sulfate. The ratio of phosphate to sulfate should be maintained at 1.25 to 1 ratio. A typical bath consists of 20 parts of sodium dihydrogen phosphate, 20 parts of manganous sulfate; 13 parts of zinc sulfate; and 947 parts of water. (Parts are by weight.)

349. ***Method of Coating Metal.*** **By Gerald C. Romig (American Chemical Paint Co.). U. S. 2,132,438. October 11, 1938.**

The solution consists of zinc oxide .5#, 75% ortho phosphoric acid .05#; and water to make 1 gallon. The current density is 50 amperes per sq. ft. The part is made cathodic and alternating current is used.

350. ***Method of Coating Ferrous Metal With a Water Soluble Metallic Phosphate.*** **By Gerald C. Romig (American Chemical Paint Co.). U. S. 2,132,883. October 11, 1938.**

The parts are sprayed with a solution consisting of zinc oxide 1.667 pounds; phosphoric acid 0.5 gallons; and water 0.5 gallons. Small quantities of sodium nitrite are added, and the pH is regulated at 2.5.

351. ***Method of Coating Iron and Steel Surfaces.*** **By Theodor B. Unger (Norway). U. S. 2,137,370. November 22, 1938.**

The method of application is in paste form and allowed to remain on surface for 24 hours. The paste consists of zinc oxide

12.5; monocalcium phosphate 72.0; Dextrine 4.0; water 75.0. (All parts by weight.)

352. *Insulating Composition.* By Charles B. Cook (Sterling Varnish Co.). U. S. 2,144,425. January 17, 1939.

The parts are treated with phosphoric acid, diammonium or sodium-ammonium acid phosphate mixed with chromic oxide, iron oxide, or other metal oxides, and china clay. Then heated or baked at 400°F. or higher.

353. *Well Covering Coating Composition.* By Friedrich Schamberger (I. G. Farben-Industrie Akt). U. S. 2,161,319. June 6, 1939.

A coating composition of the consistency of an oil paint, comprising about equal quantities by weight of an aqueous solution of a phosphoric acid having a specific gravity of about 1.3 as a binder and a pigment-like oxidic compound, which sets and hardens with the phosphoric acid.

354. *Treatment of Magnesium and its Alloys.* By Robert W. Buzzard. U. S. 2,-163,583. June 27, 1939.

A method of forming a protective coating on magnesium and magnesium alloys, comprising immersing the metal to be coated in a bath containing chromic acid and phosphoric acid adjusted to a pH of 0.5 to pH 3.5.

355. *Process for Preparation of a Rust Preventing Coating on Metallic Objects.* By Valentin A. Petkovic, Berlin, Germany. U. S. 2,163,984. June 27, 1939.

A spraying process in which two solutions are used. Solution A consists of 10-15 parts by weight of commercial glue; 1-2 parts by weight of phosphoric acid; 0.5-1 part by weight of arsenic trioxide into 100 parts by weight of water. Solution B consists of 1.5-2 parts by weight of alkali bichromate: 2-3 parts by weight of water.

356. *Art of Producing Phosphate Coatings on Surfaces of Iron, Zinc or Alloys Thereof.* By Gerald C. Romig (American Chemical Paint Co.). U. S. 2,164,042. June 27, 1939.

A pretreating solution used before phosphating consisting of 0.5 oz. oxalic acid; 0.1 copper sulfate pentahydrate; and 1 gal. water.

357. *Material for Cleaning and Preparing Metal for Paint.* By Howard R. Neilson. U. S. 2,166,476. July 18, 1939.

Concentrated metal cleaning compositions which readily dissolve in water and form solutions having comparatively low surface tension characteristics and which when applied to metal surfaces form uniform and continuous films, may be produced by combining the following ingredients in the proportions specified:

75% orthophosporic acid, 15 to 70; monobutyl ether of ethylene glycol, 15 to 30; sodium salts of the acid sulphates of multiple carbon saturated branched chained secondary alcohols, ½ to 2 and the balance water. (The proportions are in percent by volume.)

358. *Sheet Treating Machine.* By George R. Hoover, Harvey F. Miller, Benjamin P. Finkbone (American Rolling Mill Co.). U. S. 2,175,599. September 10, 1939.

Describes a machine for applying a phosphate treatment (iron, copper, sodium, or other salts) with immediate cold and hot water rinses and finally a chromic rinse.

359. *Art of Coating Metal Surfaces With a Water Insoluble Metallic Phosphate.* By Gerald C. Romig (American Chemical Paint Co.). U. S. 2,186,177. January 9, 1940.

A three step process — (1) cleaning in a hot dilute solution of sodium metasilicate and caustic soda; (2) hot rinse (water); (3) phosphate solution 1.5# zinc oxide, .5 gallon of 75% phosphoric acid, and water to make one gallon.

360. *Bearing Member.* By John H. Ballard and William H. Spencer. (Sealed Power Corp.). U. S. 2,191,435. February 27, 1940.

The parts are immersed in a solution of one part concentrated phosphoric acid saturated with iron phosphates and nine parts of water. The solution is heated to 212°F. free acid 6% and the parts remain immersed until all evolution of gas ceases.

361. *Method of and Composition for Cleaning and Rendering Metal Surfaces Immune from Rust.* By Clete L. Boyle. U. S. 2,200,615. May 14, 1940.

The parts are immersed in a solution, consisting of .05 to .2 grams per liter of a water insoluble phosphate and 7 to 15% volume of phosphoric acid, and upon removal allowed to dry without rinsing.

362. *Coating Steel.* By Vincent T. Malcolm (The Chapman Valve Mfg. Co.). U. S. 2,202,531. May 28, 1940.

The parts are immersed for varying lengths of time in a solution consisting of 100 grams electrolytic sodium hydroxide; 100 grams of water; 1 gram powdered sulphur; and 5 grams phosphoric acid.

363. *Cleaning Composition and Process.* By Van M. Darsey and Harold J. McVey (Parker Rust Proof Co.). U. S. 2,208,524. July 16, 1940.

A process which subjects the surfaces to the action of a cleaning emulsion containing a petroleum derivative, an alkali soap, and water; thereafter applying a chemical coating in a dilute phosphoric acid solution.

364. *Rust Removing Composition.* By George Witty (Frederick Le Pan). U. S. 2,209,291. July 23, 1940.

This patent uses a tri-basic phosphate compound as a rust remover and produces a rust preventing compound for use on iron. This dual purpose solution can be dipped, sprayed or brushed and consists of 36 parts H_3PO_4; 3 parts zinc phosphate; 2 parts gum arabic, 1 part manganese chloride; 30 parts butyl propionate, and 28 parts water.

365. *Method for Burnishing Iron and Steel Articles.* By Gerhard Zapf (Lubeck, Germany). U. S. 2,217,586. October 8, 1940.

Process of immersing the parts in 3 separate baths with varying concentrations for a period of 60 minutes. The main compounds were tri and disodium phosphates and sodium hydroxide.

366. *Inhibitor.* By Carl F. Prutton. U. S. 2,224,695. December 10, 1940.

A corrosion inhibitor for metal surfaces comprising an aliphatic ester of an acid of phosphorous in an oil vehicle.

367. *Material and Method for Coating Metals.* By Howard R. Neilson. U. S. 2,227,945. January 7, 1941.

A composition for causing formation of a water insoluble coating on ferrous metals. The treating bath is composed of 2-12% of 75% orthophosphoric acid and 25% of the sodium secondary alcohol sulphate and water.

368. *Rust Proofing Process.* By John MacQuaid (General Motors Corp). U. S. 2,228,836. January 14, 1941.

The parts are suspended in a chamber where blasts of air move parts around in a liquid containing basic zinc dihydrogen phosphate and an activator such as nitrate or nitrous acid.

369. *Process of Producing Iron Sheets for Laminated Electric Transformer Cores.* By August Canzler (Germany) (Eisen-und-Huttenweke A.G.). U. S. 2,230,319. February 4, 1941.

Iron sheets after hot rolling, pickling, and polishing but before they are cold rolled are treated in a solution of tri-sodium phosphate.

370. *Method of Coating Copper and its Alloys.* By Herman J. Lodeesen. U. S. 2,233,422. March 4, 1941.

Accelerated phosphate bath consisting of a solution of phosphoric acid and manganese phosphate. Chlorates, bromates, quinones, etc., are used as oxidizers instead of nitrates and nitrites.

371. *Method of Coloring Metals and Products.* By Van M. Darsey, John S. Thompson, and Edwin Goodspeed (Parker Rust Proof Co.). U. S. 2,236,549. April 1, 1941.

The parts are treated by the "Parkerizing or Bonderizing" process and then treated with a tris azo dye.

372. *Method of Treating Dynamoelectric Machines.* By Robert T. Reardon (General Elecric Co.). U. S. 2,243,578. May 27, 1941.

To increase electrical efficiency the dynamoelectric machines are immersed into a bath composed of acid phosphate such as iron and manganese dihydrogen phosphate.

373. *Metal Finishing Process.* By Gerald C. Romig (American Chemical Paint Co.). U. S. 2,245,609. June 17, 1941.

The phosphate coating consists of an acid zinc dihydrogen solution containing hydrogen peroxide, and then followed by a dilute chromic acid rinse (½ to 8 pounds per 100 gallons).

374. *Coating Composition.* By Ladislaus Balassa (E. I. du Pont de Nemours & Co.). U. S. 2,260,819. October 28, 1941.

A coating composition comprising the reaction product at room temperatures of a blown oil having drying properties and from 1 to 3% phosphoric acid, a resin, and solvents said reaction product having been dispersed in solvents before any rubbery gel is produced, the solids of said composition being below about 50%.

(*Continued on page* 73)

Science for Electroplaters

38. Alcohols

By L. Serota

ALCOHOLS represent a class of organic compounds in which one or more hydrogens of the hydrocarbons are replaced (substituted) by the hydroxyl (OH) group. A second interpretation considers alcohols as derived from water, wherein substitution of one of the hydrogen atoms by a univalent organic radical, usually represented by R, takes place. Thus HOH (water) → ROH (alcohol).

Alcohols of the simplest type contain only one hydroxyl group, a monohydroxyl substitution product; thus $CH_3{\cdot}H$, methane, becomes CH_3OH, methyl alcohol; $C_2H_5{\cdot}H$, ethane, changes to C_2H_5OH, ethyl alcohol, or a higher member (long chain) of the paraffin series, $C_{16}H_{33}OH$, which is called cetyl alcohol.

A phosphate brush-on chrome pickle, used as a touch-up for finishes for magnesium, lists ethyl alcohol as one of the reagents. A formula for electropolishing phosphor bronze, silicon bronze, Monel and Nichrome consists of 2 parts methyl alcohol (absolute) to 1 part nitric acid.

C. B. F. Young, in discussing nonionic surface-active agents for alkaline cleaners, lists long-chain alcohols with a number of free hydroxyl groups for one such class of compounds. *C. A. Disher* and *F. C. Mathers* found that a mirror-bright deposit was obtained when n-aliphatic alcohols having 2-12 carbon atoms were tested as brightening agents for a stannous sulfate-sulphuric acid bath, and that n-octyl alcohol, $C_8H_{17}OH$, gave best results. The n-octyl alcohol was used as the sodium sulfate ester of the aliphatic alcohol. *V. C. H. Brockwell* lists cetyl alcohol, $C_{16}H_{33}OH$, as the wax in an effective self-emulsifying buffing composition.

In a study on the influence of aliphatic compounds as addition agents on nickel deposits, reported by *E. Raub* and *M. Wittum*, the authors conclude that alcohol with 2 or 3 carbon atoms, also polyhydric alcohols from glycerine down, may be classified as weak brighteners. Weak brighteners increase only slightly the reflectivity of the nickel and produce deposits with mat or milk brightness.

A phase of electroforming, in which the metal cannot be removed readily, is the formation of a film of silver iodide on copper phonograph matrices or map plates. The treatment is based upon the displacement of copper when a silver cyanide solution is applied to the surface. The thin film of silver produced is then treated with a solution of iodine which changes the silver film to a silver iodide film. Deposition and separation of the deposited metal is then possible. The iodine and potassium iodide are dissolved in a mixture of water and ethyl alcohol.

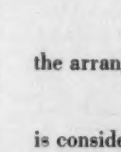
Metal deposition (silver) on nonconducting surfaces such as glass, wax, or plastic depends upon the formation of a silver film by the use of an ammoniacal silver nitrate solution and a reducing agent like formaldehyde. Prior to silvering, the surface is sensitized with stannous chloride and stannous sulfate solutions. The stannous sulfate reagent contains 150 ml. ethyl alcohol per liter. A patented conducting coating reported effective as a surface electrode for electroforming consists essentially of silver powder and some stearic acid suspended in absolute alcohol. Absolute alcohol is practically anhydrous (less than 0.5 percent water) ethyl alcohol.

A patent on aluminum polishing processes reports the following bath composition: phosphoric acid (1.58) 90% by vol.; butyl alcohol (C_4H_9OH) 10% by vol. Operating conditions are included. A patent abstract refers to a process for depositing a film of indium salt by spraying on glass, previously heated to 400°F., for the purpose of producing an electro-conductive article. The composition given is 170 cc. indium trichloride; 1000 cc. methanol (CH_3OH); 6 grams ammonium bifluoride.

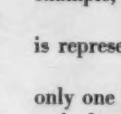
The naming of alcohols may be done in different ways. Thus, for the lower aliphatic alcohols, the alkyl group designates the name, such as methyl alcohol (CH_3OH); ethyl alcohol (C_2H_5OH). For higher alcohols the I.U.C. system is preferably employed, with the ending -ol used to represent the longest chain containing the hydroxyl group, as 1-butanol ($CH_3CH_2CH_2CH_2OH$) for butyl alcohol, the "1" indicating the number of the carbon to which the OH group is attached. The third method considers the alcohols as derivatives of the first alcohol, CH_3OH or $H\diagdown CH.OH\diagup H$, which is called "carbinol." By this order 1-butanol becomes normal or n-propylcarbinol, $C_3H_7\diagdown CH\ OH\diagup H$ (C_4H_9OH); and 2-butanol $CH_3CH_2CHOHCH_3$, with the OH group attached to the second carbon atom, becomes ethyl methyl carbinol $CH_3\diagdown CH\ OH\diagup C_2H_5$ (C_4H_9OH), with substitution of two hydrogens in the carbonyl formula, by the alkyl group methyl (CH_3) and ethyl (C_2H_5).

Primary, Secondary, Tertiary Alcohols

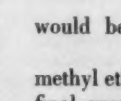
A further classification of alcohols is based upon the number of carbon atoms attached to a C-OH arrangement. Thus, when the group consists of the arrangement



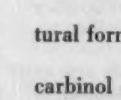
—C—OH, the alcohol is considered a primary alcohol. As an example, the formula for ethyl alcohol is represented as



When only one hydrogen instead of two is attached to the C-OH group, a secondary alcohol forms. A typical formula would be



(C_4H_9OH), methyl ethyl carbinol or 2-butanol. The final group, with three hydrogen substitutions, is called a tertiary alcohol and may be represented by the structural formula



tri-methyl carbinol or tertiary butanol.

Primary, secondary and tertiary alcohols differ in the end products resulting from oxidation. The changes are as follows:

primary alcohol → aldehyde → acid

secondary alcohol → ketone → decomposition

tertiary alcohol → decomposition

W. L. Pinner and associates note that the sulfates of normal primary alcohols consisting of 8 to 18 carbon atoms were the earliest type of wetting agents used, sodium lauryl sulfate being the most effective. *J. A. Smith* and *R. J. Rowe* in their research report on removal of manganese from (Watt's type) nickel solutions, indicate that sodium lauryl sulfate was used in sufficient quantities to prevent pitting on the face of the panel. *I. L. Newell,* reporting in the same reference on the effect of several addition agents on the hardness and residual stress in nickel deposits from a nickel sulfamate bath, gives the following bath composition as the basic formula for the tests: nickel sulfamate 250 g./l., sodium chloride 10 g./l., boric acid 15 g./l., sodium lauryl sulfate 0.15 g./l. *H. J. Weiner* found that the use of 0.1 0.2 g./l. sodium lauryl sulfate as an addition (wetting) agent in a heavy rhodium plating bath eliminated the difficulty of pitting encountered as a result of adhesion of hydrogen gas bubbles to the surface of the cathode, especially on sharp edges. Vigorous agitation could not overcome this condition. An added benefit of the addition agent was the reduction in solution loss previously caused by hydrogen spray.

This detergent is made by treating lauryl alcohol with sulfuric acid, which yields the alkyl, lauryl hydrogen sulfate. An alkali such as NaOH, will convert the alkyl hydrogen sulfate into its sodium salt.

$$C_{12}H_{25}OH + H_2SO_4 = C_{12}H_{25}{-}O{-}\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}{-}OH + H_2O$$

$$C_{12}H_{25}{-}O{-}\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}{-}OH + NaOH =$$

$$C_{12}H_{25}{-}O{-}\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}{-}O{-}Na$$

Polyhydroxy Alcohols

Alcohols may contain more than one hydroxy group, but each OH group must be attached to a separate carbon atom in the chain. The simplest type would be a dihydroxy alcohol. Such an alcohol is known as a glycol. Ethylene glycol, $CH_2OH{\cdot}CH_2OH$, used as a solvent and as anti-freeze in automobiles, is an example. An anodic treatment employing an alkaline bath produces a hard, abrasion-resistant coating on magnesium from a bath composition which includes ethylene glycol.

The commonest of the trihydroxy alcohols, glycerol (glycerine), $C_3H_5(OH)_3$, is present as part of the compounds comprising fats and oils, known chemically as glyceryl stearate (glycerides). When such compounds are treated with an alkali, NaOH or KOH, the fat or oil reacts to form soap, with the release of glycerine. This reaction is known as saponification. Hydrocarbons, however, such as gasoline, lubricating oils, or paraffin, do not undergo chemical changes by such treatment, and are said to be unsaponifiable. Waxes, therefore, of the saponifiable glyceride type used in buffing compounds or stop-offs, will yield glycerine in the alkaline cleaning process.

F. C. Mathers and *W. J. Guest* found experimentally that the addition of glycerine (14.6 oz./gal.) to a zinc sulfate bath gave improved throwing power without affecting the quality of the plated surface. Because of the large quantities required, a cheaper grade, "glycerine foots," is recommended. *S. Wernick* and *R. Pinner* refer to the use of glycerine (15-20%) as an addition agent (inhibitor) in producing films (oxide coatings on aluminum and its alloys) of higher plasticity from a sulfuric acid anodizing bath.

In a comprehensive review of uses of glycerine in metal finishing, *E. S. Pattison* includes some major applications. One of the most important is electropolishing of stainless steel, wherein the glycerine serves as a major component of phosphoric acid baths. Thus, a bath consisting of 40-50 percent phosphoric acid and 60-50 percent glycerine was used (C.D. .1-.2 amp./sq. in. at 40-125°C.) for electropolishing stainless steel spinning jets for extruding rayon. Another example cited was the electropolishing of stainless steel hypodermic needles in a solution consisting of 4 parts sulfuric acid (sp. gr. 1.84), 2 parts glycerine (sp. gr. 1.26) and 3 parts water. Anodic polishing occurred at a temperature of 30-35°C. with 4 amp./sq. in. at 15 volts.

For finishing light metals such as magnesium and magnesium base alloys, an electrolytic bath for producing a protective anodic coating includes glycerine. The same (glycerine) treatment, the author notes, applies to anodizing aluminum. Newer aluminum treatments include a process for the controlled etching of aluminum in solutions of strontium and barium hydroxides. Up to 10 percent glycerine is included to promote smoother electrolysis. Mention is made of several recent patents specifying the use of glycerine in the electrodeposition of molybdenum and molybdenum-cobalt alloys.

A composition for barrel or tumble finishing lists the following ingredients for coating fibrous carriers in the burnishing or smoothing step: tallow or lanolin, 29 percent; glycerine(13 percent; oleic acid, 12 percent; stearic acid, 10 percent; tripoli or other abrasive (320-400 mesh), 12 percent; chalk, aluminum oxide or other fine polishing powder, 24 percent. Abrasives of this kind are said to be superior to older types. They do not cake in the openings and crevices of articles being polished and they do not create health hazards because of dust.

A higher polyhydric alcohol, powdered mannitol, a sugar, $CH_2OH(CHOH)_4CH_2OH$, is used in one of the methods of analysis for boric acid in a Watt's nickel bath. Glycerine may be substituted. The boric acid serves to transform the weak tribasic boric acid into a strong monobasic acid, which can be titrated with the standard alkali.

$$C_6H_{14}O_6 + H_3BO_3 \rightarrow C_6H_{12}O_6{\cdot}BOH + 2H_2O$$

The use of polyhydric alcohol compounds in non-ionic surface-active agents, as indicated by *C. B. F. Young,* fits into one of the following categories: partial esters of polyhydric alcohols with long chain of carboxylic acids; ethers of polyhydric alcohols with long chain fatty alcohols; esters of long chain alcohols with polyhydric acids; long chain acetals of polyhydric alcohols. *N. Hall* reported the addition of aliphatic poly-alcohols to a patented electropolishing solution for aluminum, consisting of sulfuric acid and phosphoric acid. *D. G. Foulke* reported on a patented process for producing a mirror-bright silver plating by the use of a complex prepared from 1 part of an antimony compound, Sb_2O_3, and 1-6 parts of a polyhydroxy aliphatic com-

pound such as sorbitol, $CH_2OH(CHOH)_4CH_2OH$, erythritol, $CH_2OH(CHOH)_2CH_2OH$, or glycerine in a bath containing a tartrate-free, alkali-silver-cyanide solution.

A brightener patent for depositing zinc from a cyanide plating bath, contains as one of the additives in the brightener solution 8 to 12 percent by dry weight of polyvinyl alcohol. Polyvinyl alcohol (water-soluble) is obtained when polyvinyl acetate is saponified or hydrolyzed.

Aldehydes

Oxidation, under controlled conditions, of a primary alcohol will yield, instead of carbon dioxide and water, an intermediate oxidation product known as an aldehyde. Thus ethanol, a primary alcohol, changes as follows:

$$CH_3CH_2OH \rightarrow [O] \rightarrow CH_3-C\begin{matrix}/H\\ \backslash OH\end{matrix}$$

OH. This compound is an unstable intermediate, because two hydroxyl groups, when attached to a single carbon atom, will lose a molecule of water, leaving the compound $CH_3-C\begin{matrix}/O\\ \backslash H\end{matrix}$, acetaldehyde. The term aldehyde is a condensation of alcohol dehydrogenatus, or alcohol less hydrogen. The group $-C\begin{matrix}/O\\ \backslash H\end{matrix}$ or $R.C\begin{matrix}/O\\ \backslash H\end{matrix}$ is the characteristic of the aldehyde group. The first member of the aldehyde series, formaldehyde, is obtained by the oxidation of methanol

$$CH_3OH + [O] \rightarrow HCHO + H_2O$$

Formaldehyde

Formaldehyde is a gas with an irritating odor, very soluble in water, and generally available as a 40 percent solution. It is used in this form as the reducing agent for the deposition of silver films on non-conductive surfaces, when mixed with an ammoniacal silver nitrate (plus potassium hydroxide) solution in the ratio of one volume reducing solution to five volumes of the ammoniacal silver nitrate. The equation for this reaction is as follows:

$$HCHO + 2Ag(NH_3)_2OH \rightarrow HCOONH_4 + 2Ag + 3NH_3 + H_2O.$$

The aldehyde is oxidized to the acid (formic) which, in turn, forms the salt ammonium formate.

W. L. Pinner and associates refer to the effectiveness of aldehydes, especially formaldehyde, as brighteners of the second class for Watt's-type or high chloride nickel baths which, when used in conjunction with brighteners of the first class, reduce brittleness and stress in bright nickel baths. When such brighteners are added to a bath, the authors indicate, hydrogen peroxide, which will oxidize unsaturated organic brighteners, cannot be used to prevent pitting.

In a study of the influence of organic compounds in nickel plating solutions, *E. Raub* and *M. Wittum* reported the following on aldehydes: formaldehyde will give bright nickel deposits, which are rather brittle and exhibit a reflectivity only slightly below buffed nickel; brittleness increases with thickness of coating without any noticeable decrease in adhesion; organic materials are co-deposited with nickel from solutions containing formaldehyde, a condition attributed to the ease of polymerization of formaldehyde by which colloidal matter forms; a pronounced increase in polarization occurs; for still baths, plating in the presence of formaldehyde at low current densities will result in brittle and black-streaked coatings; for best properties, a concentration of 1 to 1.4 oz./gal. formaldehyde in the solution is considered the most satisfactory.

Acetaldehyde, CH_3CHO, affects nickel deposition similarly to formaldehyde, its effect, however, being stronger. Deposits from baths containing this aldehyde are covered with hair-like cracks.

S. Wernick and *R. Pinner* discussed an improved chromate conversion process (aluminum-oxide coating) by the addition of a corrosion inhibitor such as chromic acid, a hardening agent such as formaldehyde, and a protein which serves as the carrier for the inhibitor.

L. Weisberg reported that experimental results indicate that the addition of 4.6 oz./gal. sodium formate and 0.12 oz./gal. formaldehyde to a cobalt-nickel sulfate bath contributes to the brightness of the deposit to the extent that the deposited alloy need not be buffed or colored. The sodium formate is added for its buffer action at a pH of 3.7; the formaldehyde serves as a depolarizer and anti-pitting agent. The deposits are reported to exhibit a mirror-like surface, surpassing in brilliance a buffed surface, since wheel marks are absent. The resulting brightness of the surface is specular, with very little diffused reflection. During the discussion period following presentation of the paper, the author stated that the freedom of pits in this deposit could not be attributed to the lowering of the surface tension by the formaldehyde. Measurements showed that the surface tension is about the same as that of a warm nickel solution. In a later report the author noted that sodium formate was replaced in this bath by nickel formate.

Resins

Formaldehyde will react with phenol, C_6H_5OH, to form a phenolic resin, a condensation product of the straight chain (linear) type polymer which may proceed to form the three-dimensional network, a characteristic cross-linked polymer. It is one of the earliest of synthetic resins manufactured and is known commonly as Bakelite. This type of resin is infusible (thermosetting) and hard.

R. J. Meyers and associates, in a review of synthetic resins used as adsorbents (ion exchange), lists phenol-formaldehyde resins as cation-exchange adsorbents and amine-formaldehyde resins as anion-exchange adsorbents.

Tanks made with a composition of phenol-formaldehyde resin and acid-digested asbestos fiber resist thermal shock and may be used up to temperatures of 265°F. Such tanks are strong, tough, and durable, as well as possessing good corrosion resistant qualities. Acids, salts, and weak bases, as well as many solvents, may be stored in this type of tank. Oxidizing agents or strong bases like sodium hydroxide will attack this tank composition. A second type of composition tank consisting of phenol-formaldehyde resin and graphite is especially adaptable for hydrofluoric acid and related compounds. It is less resistant to shock than the other type described, and can withstand higher temperatures.

Organic Coatings

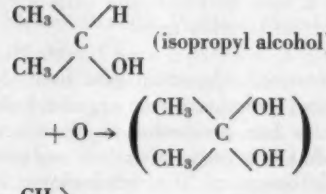
The restrictions on the use of nickel for coating needs during the military preparedness program posed a difficult problem for the plating industry because of the poor protective quality of chromium finish when plated directly on copper. This applied particularly to the automobile manufacturing industry. An approach to this problem was the application of clear organic coatings. *W. R. Fuller* referred to the satis-

factory results obtained by the use of a combination alkyd and amino (urea or melamine) — formaldehyde resin which was sprayed on copper-chromium test panels. A dry film of about 1 mil thickness remained which was baked at 300°F. (149°C.). Some tests made included water immersion 100°F. and salt fog 95°F., each for a period of 168 hours; exposure to 50 percent acetic acid for 4 hours as an indication of resistance to perspiration and an impact test for adhesion.

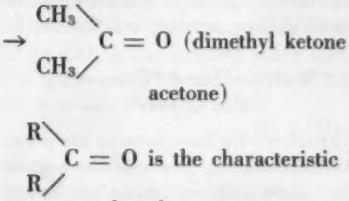
The author also reported that a clear baked finish now used on brass builders' hardware consists of a combination of expoxy resin with urea-formaldehyde resin. A satisfactory coating with a film of 0.3 to 0.5 mil is possible without objectionable coated appearance because of the paler color and toughness of this resin mixture. Several dip coats are required, and the coated resin is then baked for 20 minutes at 350°F. For brass plated zinc die castings, which cannot be baked above 270°F., a combination phenolic (phenol-formaldehyde) resin containing a small amount of urea-formaldehyde resin may be applied and baked at 270°F.

Ketones

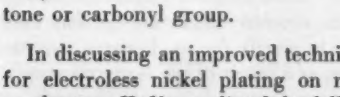
Oxidation of a secondary alcohol will yield a ketone, instead of an aldehyde. The equation for this change with isopropyl alcohol is as follows:



(isopropyl alcohol)



(dimethyl ketone or acetone)



is the characteristic ketone or carbonyl group.

In discussing an improved technique for electroless nickel plating on nonconductors, *H. Narcus* listed the following formula for roughening procedure when thermosetting resins are used: 400 cc. hydroquinone; 100 cc. pyrocatechin; 4000 cc. acetone (a ketone).

S. Wernick and *R. Pinner* refer to the impracticality, under normal commercial conditions, of the use of acetone for rinsing purposes in chemical etching processes for light metals (aluminum). *W. L. Pinner* and associates include ketones in their recommendation for brighteners as addition agents of the second class for nickel plating baths.

E. Raub and *M. Wittum* in a report on organic compounds in nickel baths, indicated that an addition of 10 cc. per liter of acetone results in milky bright to bright deposits. Adhesion to the basis metal, however, is poor and the deposits exfoliate even in the bath. Heavier coatings from acetone containing baths are gray to gray black.

PHOSPHATING TREATMENTS

(*Continued from page 69*)

375. ***Pretreated Bearing Surface and Method of Producing the Same.*** By G. L. Neely, Bruce B. Farrington, and Victor Borsoff. (Standard Oil Co. of California). U. S. 2,266,377. December 16, 1941.

A coating to aid the "breaking-in" of pistons, cylinders, piston rings, etc., is produced in a solution of 1000 grams caustic soda (37%) and 50 grams of sulfur dissolved by heat 265°F. The coating that is produced is composed (by authors) of a $Fe_3(PO_4)_2 \cdot H_3PO_4$ phosphate coating.

376. ***Extreme Pressure Lubrication.*** By Robert K. Floyd (Standard Oil Co. of California). U. S. 2,266,379. December 16, 1941.

The surfaces of pistons, tools, etc., are treated by immersion in a solution operating at 210° F and consisting of 4 oz. phosphoric acid, 1 oz. iron fillings, 1 oz. ferrous phosphate, 1 oz. manganese phosphate, and 160 fl. oz. water.

377. ***Fastenings (Nails).*** By Theodore J. Martin and A. Van Kleeck. U. S. 2,268,323. December 30, 1941.

Increase the resistance of fastenings (nails) for wood by immersing the fastenings for 7 hours in a 10% solution of mono-ammonium phosphate.

378. ***Process of Coating Metal Surfaces.*** By Cecil J. MacKay (Rust Proofing Company of Canada, Limited). U. S. 2,271,374. January 27, 1942.

The surfaces are subjected to a molten bath consisting of sodium nitrate, sodium hydroxide and a phosphate.

379. ***Method of Coating Copper and its Alloys.*** By H. J. Lodeesen (Parker Rust Proof Co.). U. S. 2,272,216. February 10, 1942.

Treat the copper before painting in a solution consisting of 42 lbs. zinc dihydrogen phosphate; 8 lbs. ammonium persulfate in 100 gal. of water for 5 minutes. A 15 min. processing bath consisting of manganese, phosphate, phosphoric acid, zinc carbonate, sodium nitrite, and water.

380. ***Metal Treating Solution.*** By Van M. Darsey (Parker Rust Proof Co.). U. S. 2,293,716. September 15, 1942.

The parts are immersed into a solution consisting of 52° Be nitric acid 400; 75% phosphoric acid 1,075; zinc oxide 420; sodium chlorate 500; copper carbonate 2.5; and water to make 5000. (All figures are in pounds.)

381. ***Method Coating Method and Article Produced Thereby.*** By Robert R. Tanner (Parker Rust Proof Co.). U. S. 2,293,779. August 25, 1942.

Objects that are zinc or nickel coated are heated and then immersed into a solution consisting of zinc metal, iron, phosphoric acid, anhydrous zinc nitrate, zinc dihydrogen phosphate, 42° Be nitric acid, and water.

382. ***Method and Material for Treating Metal Surfaces.*** By Theron P. Remy. U. S. 2,294,571. September 15, 1942.

The parts are immersed in or sprayed with a solution consisting of 1400 cc of phosphoric acid; 1500 cc water; 750 cc ethyl alcohol; 190 cc butyl alcohol; 75 cc of hydrogen peroxide; 40 cc of titanium tetra chloride.

383. ***Treatment of Metal.*** By Wilfred James Clifford and Henry Howard Adams. (England) (Parker Rust Proof Co.) U. S. 2,295,545. September 15, 1942.

The process of phosphating can be accelerated by the addition of a compound (organic) containing a non-ionic nitro group such as puric acid, nitrobenzene, and nitrophenol.

384. ***Friction Part and Method of Treating.*** By Cecil W. Glasson (Parker Rust Proof Co.). U. S. 2,296,844. September 29, 1942.

The parts are immersed into a solution consisting of zinc dihydrogen phosphate 900#, zinc oxide 250#, nitric acid 42 Be 700#; sodium nitrate 600#, and water 5000#.

385. ***Method of Lubrication and Treating Gears.*** By George Leonard Neely, Bruce B. Farrington, and Victor N. Borsoff (Standard Oil Company of California). U. S. 2,297,909. October 6, 1942.

One of the recommended methods consists of treatment of the gears for 30 minutes to 1½ hours in an aqueous solution consisting of 10% H_3PO_4 saturated with $Fe_3(PO_4)_2$.

386. ***Treatment of Metal.*** By Wilfred J. Clifford and Henry H. Adams (England). (Parker Rust Proof Co.) U. S. 2,298,280. October 13, 1942.

Treatment consists of using N/5 solutions of zinc or manganese dihydrogen phosphate with 0.4% hydroxylamine as an accelerator.

387. ***Method of Phosphate Coating Ferrous Metal Surfaces.*** By Gerald C. Romig (American Chemical Paint Co.). U. S. 2,298,312. October 13, 1942.

The method consists of cleaning the surface preparatory to coating by washing the surface with an alkaline cleaner in which is emulsified a solvent oil chosen from red oil, anthracene oil, creosote oil, pine oil, and high flash coal tar naphtha. The surface is then rinsed and treated with acid zinc phosphate solution.

388. ***Process for Machining Metals Using Cutting Tools.*** By Gerhard Roesner and Ludwig Schuster (American Lugri Corp.). U. S. 2,298,418. October 13, 1942.

In machining metals, the step of cutting the metal in the presence of an aqueous solution containing the chromic acid radical and the phosphoric acid radical which is chemically active on the metal.

SHOP PROBLEMS

BARREL FINISHING — POLISHING AND BUFFING
CLEANING — ANODIZING — ELECTROPLATING
RUSTPROOFING — LACQUERING AND ENAMELING

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Pickling Waste Recovery

Question: We have just learned of a new European process for treating pickling wastes in which both the iron and the sulfuric acid are recovered by the use of muriatic acid but can find no reports on the method in the literature. Do you have any data in your files on any such process and, if so, please forward same.

J. S. S.

Auswer: You are probably referring to the "Ruthner" process, which is receiving a great deal of hopeful attention from American steel mills. In this process a closed chamber is employed, in which the sulfuric acid is supersaturated with gaseous hydrochloric acid. This causes ferrous chloride crystals to precipitate. The crystals are removed from the pickling solution and roasted to convert them to iron or iron oxide. The hydrochloric acid, which is liberated during roasting, is returned to the pickling chamber.

Complete details will be found in U. S. Pat. 2,785,999 (March 19, 1957) granted to O. Ruthner.

Lacquering Over Chromium Plate

Question: One of our products requires a colored organic finish to be applied over a chromium plated surface to produce a two-toned effect. We have heard of the use of a chromic acid rinse prior to lacquering, in order to obtain adhesion, but hesitate to use it because we would have a problem of chromic acid waste disposal in our location. Is there any other process we might use to obtain satisfactory adhesion? If so, we would appreciate your furnishing us with details on same.

A. D. C.

Answer: Since the part need not be rinsed after the chromic acid dip, there would be no waste disposal problem. After dipping in a hot 2% solution, the parts are allowed to dry and are then lacquered. Good adhesion has also been claimed for the procedure in which a 2% solution of tetra-N-butyltitanate in isopropyl alcohol is sprayed over the chromium plate and baked for 5 minutes at 225 deg. F. prior to lacquering.

Aluminum-Clad Copper Wire

Question: Can you give us any information on the method of coating copper wire with aluminum? We have been told that hot dipping results in a brittle copper-aluminum alloy layer between the two metals which will give trouble if bent or wound on spools. Is there any way in which this condition can be eliminated?

G. W. I.

Answer: The usual method of producing aluminum-clad copper wire is to silver plate the copper rod, which is then inserted in an aluminum tube. The assembly is then rolled and drawn to size. The silver deposit acts as a barrier layer between the aluminum and copper, thus avoiding the formation of the brittle copper-aluminum alloy.

Electrolytic Purification

Question: What operating conditions would you suggest for purification of nickel plating solutions by electrolytic treatment? Is agitation of the solution necessary for good results and is a separate tank desirable for the treatment?

L. D. C.

Answer: A current density of about 5 amp./sq.ft. is recommended for electrolytic purification of nickel baths and, since the efficiency of the process depends greatly on the rate of agitation, mild air agitation is recommended, although cathode movement will also be satisfactory.

Continuous electrolysis is most effective, which will require a small treatment tank alongside the plating tank. The solution can be siphoned from the plating to the treatment tank and, from there, pumped through the filter back into the former. Five amperes are required for each 100 gallons of solution and, since a current density of 5 amp./sq. ft. will effectively remove impurities, one-half square foot of corrugated sheet iron is used for each 100 gallons of solution. Anode to cathode spacing in the treatment tank need be only 3-4 inches from the high spots of the corrugations, so that quite a lot of cathode surface can be employed in a fairly small tank.

Deposition of Aluminum

Question: Do you have a formula for a bath in which you plate aluminum on to other metal?

H. M.

Answer: Aluminum has been deposited from complex organic baths but, to date, production problems have limited their use to laboratory and pilot scale operation. The metal cannot be deposited from aqueous solutions.

"Walrine" and "Removing the Green"

Question: We have been in the jewelry manufacturing business for a great many years and have come across two terms recently which no one has been able to clarify for us. Perhaps you can help, as a result of the many sources of information available to you, since we can think of no other source from which we might receive assistance in this matter. The terms are "Walrine" and "Removing the Green."

D. M. C.

Answer: Walrine wheels are polishing wheels made by cementing together sheets of split leather. "Removing the

Green" is the process of gold "stripping" or pickling, for the purpose of removing flux and oxide from karat gold articles. The parts are soaked in a hot 10% by volume solution of sulfuric acid, to remove flux and oxide. They are then brightened by "stripping" with reverse current at 12 volts in a hot solution of 4-8 oz./gal. potassium cyanide to which potassium ferrocyanide or rochelle salt is sometimes added. A stainless steel pot or tank is used, which is made the cathode. The gold which deposits on the sides of the tank can be peeled off and recovered.

Black Chromium

Question: I would like to experiment with black chrome plating and would, therefore, like to know the solution formula.

L. V. T.

Answer: A black deposit may be obtained from a solution of chromic acid, ammonium metavanadate and acetic acid, according to M. F. Quaely (U. S. Pat. 2,824,829).

A typical solution is as follows:

Chromic acid	26.8 oz./gal.
Ammonium metavanadate	2.7 oz./gal.
Glacial acetic acid	0.18 fl. oz./gal.
Temperature	95-122° F.
Current density	930 amp./sq. ft.
Voltage	12-15

Nickel Plating Porous Metal

Question: I have a problem in plating porous brass castings, which come from the bright nickel tank very rough at the location of the pores and holes. I degrease and electroclean the buffed castings, then dip in HCl, copper flash and nickel plate. The roughness is not due to dirt in the solution since other work does not show this effect. Any advice would be appreciated.

M. J. H.

Answer: The roughness may be due to precipitation of nickel salt by the alkali leaking out of the holes in the metal.

Since the first solution which gets into the holes usually stays there, an acid dip will not neutralize the cleaner completely. It is suggested that the parts be soaked in hot water for a few minutes before going into the cleaner, so that the holes will be filled with water rather than with alkali. The copper strike should be eliminated, or an acid dip used afterward.

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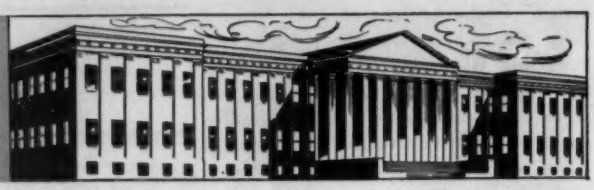
Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD



Hot Dipping Aluminum

U. S. Patent 2,817,312. *Dec.* 24, 1957. *T. H. Westby.*

In a continuous line coating operation, a bath for containing molten aluminum at from 1200° to 1250° F., a sinker bar adjustably positionable in said bath for directing a continuous line of stock into immersion within said bath, apparatus for pulling said stock out of said bath at an angle in accordance with the position of said sinker bar, a supporting way inclined to correspond substantially with said angle, a series of wiping implements and a rack for mounting said wiping implements for the removal of excess aluminum from said stock, said rack including adjustment means for anchoring itself at variable distances from the bath onto said supporting way.

Pouring Lip for Paint Cans

U. S. Patent 2,817,465. *Dec.* 24, 1957. *H. P. Gray.*

A pouring spout attachment for application to cylindrical pails having tops and curved sealing channels having inner and outer walls and an outer rim.

Caustic Black for Steel

U. S. Patent 2,817,610. *Dec.* 24, 1957. *I. L. Newall and E. A. Walen.*

A composition for the blackening of ferrous metals consisting essentially of alkali metal hydroxide 50 to 90 parts by weight, alkali metal nitrate 0.1 to 50 parts by weight; alkali metal nitrite 3 to 20 pars by weight; together with 0.1 to 25 parts by weight of at least one compound chosen from the group consisting of soluable alkali metal thiocyanates; thiourea and alkyl thioureas.

Electroless Nickel

U. S. Patent 2,819,188. *Jan.* 7, 1958. *D. E. Metheny and P. Talmey, assignors to General American Transportation Corp.*

The process of chemically plating with nickel a solid body of catalytic material, which comprises providing a hot aqueous chemical nickel plating bath of the nickel cation-hypophosphite anion type, injecting a light gas from an external source into said hot plating bath in order to maintain a substantial dispersion of said light gas in said hot plating bath, said light gas being chemically inert with respect to said hot plating bath and having a molecular weight that is not greater than that of neon so that it has a high diffusion rate in said hot plating bath and a low surface tension with respect thereto, and contacting said body with said hot plating bath having said substantial dispersion of said light inert gas therein, whereby a bright smooth nickel plating is deposited upon the surface of said body.

Process for Enameling Steel

U. S. Patent 2,819,207. *Jan.* 7, 1958. *G. A. Shepard, assignor to Republic Steel Corp.*

The method of producing a tenaciously adhering, substantially uniform and continuous porcelain enamel coat on a ferrous metal article which comprises the steps of removing substantially all loose particles and foreign matter from the surface of said article; electrodepositing on the thus cleaned surface a substantially uniform thickness coat of spongy burned metal selected from the group consisting of nickel and cobalt and of weight in excess of about 0.4 grams per square foot, applying porcelain enamel slip directly to the resulting electroplate surface, and firing said slip and producing said enamel coat, said electrodeposition step being conducted to produce a metal coat of the finely-divided and spongy character of the metal coat produced by immersing a clean ferrous metal body as a cathode approximately one inch from a lead anode in an aqueous solution containing about 100 grams per liter of ammonium sulfate and about 10 grams per liter of a substance selected from the group consisting of nickel sulfate and cobalt sulfate at about 200°F. for between about 5 and about 15 seconds while imposing upon the electrodes a ten-volt current.

Paint Roller Cleaner

U. S. Patent 2,819,483. *Jan.* 14, 1958. *C. R. Macaulay.*

A cleaning apparatus for paint rollers comprising a container for receiving a cleaning solvent, a cylindrical roller cleaner having its longitudinal axis disposed vertically in said container and adapted to embrace and scrape the exterior of a paint roller when the latter is reciprocated therein, said cleaner comprising a grid disposed into a cylindrical sleeve with its vertical edges overlapping circumferentially, means for adjustably securing the overlapping edges whereby to vary the diameter of the sleeve for adapting it to slidably receive different sizes of paint rollers.

Abrasive Wheel

U. S. Patent 2,819,567. *Jan.* 14, 1958. *E. W. Hall, assignor to F. L. & J. C. Codman Co.*

A rotary abrading wheel comprising a plurality of axially juxtaposed elements, each including a board of agglomerated fibers in the form of a disc, and upstanding strips of flexible sheet material having a coating of abrasive granules adherent thereon.

Paint Toning

U. S. Patent 2,819,738. *Jan.* 14, 1958. *E. H. Marberg, assignor to National Chemical & Manufacturing Co.*

A method of producing a paint or other surface coating of a predetermined color by the admixture of a predetermined and measured quantity of pigment with a predetermined and measured quantity of non-pigmented base ingredients.

Metalizing

U. S. Patent 2,819,982. *Jan.* 14, 1958. *W. Westerveld, J. W. Van Tyen and B. Haes, assignors to North American Philips Co., Inc.*

A method of producing silver mirrors comprising the steps, introducing an alloy of silver and a minute amount of silicon into a metallic filament consisting essentially of a refractory metal

having a high melting point, and heating to incandescence said filament to evaporate the silver therefrom and deposit said silver on the surface of a body placed in the vicinity of said filament thereby to form a silver mirror on said body.

Current Density Indicator and Control

U. S. Patent 2,820,004. *Jan.* 14, 1958. *G. H. Rendel, assignor to U. S. Steel Corp.*

A current density indicator and control for a continuous strip processing line for removing material from said strip in which strips of different widths pass through an electrolyte.

Annular Brush Element

U. S. Patent 2,820,235. *Jan.* 21, 1958. *B. E. Nelson, assignor to The Osborn Mfg. Co.*

As a new article of manufacture, an annular brush element comprising a single circular turn of a length of brush strip having a continuous elongated channel back portion with brush material retained therein and extending generally radially outwardly of such turn.

Paint Brush Guard

U. S. Patent 2,820,237. *Jan.* 21, 1958. *J. Maslaney.*

A guard attachment for paint brushes comprising: a handle part adapted to slidably fit over a paint brush handle; a guard part adapted to slidably fit over one face of the bristles of said paint brush and an intermediate part connecting said handle and guard parts.

Lead Anode

U. S. Patent 2,820,005. *Jan.* 14, 1958. *W. E. Belke and H. J. Johnson, assignors to Belke Mfg. Co.*

A lead anode assembly for electroplating comprising, a connector hook having an upper V-shaped formation for engaging an anode rod and effecting an electrical connection, said hook having a threaded bolt extending laterally from its lower end in a direction similar to the direction of the anode rod, a lead electrode mounted on said bolt and depending therefrom, and a threaded member on the threaded end of said bolt clamping the electrode between said threaded member and a shoulder at the other end of said bolt, the said electrode comprising a bar of lead alloy material having an aperture in its upper end, and having the rest of its body formed with a multiplicity of folds extending back and forth forming an elongated corrugated electrode, the corrugations being substantially V-shaped in form with rounded apices, and the corrugations being deformed at the end about said aperture for said bolt until the corrugations are brought into firm engagement with each other.

Protecting Phosphated Surfaces

U. S. Patent 2,820,723. *Jan.* 21, 1958. *W. M. LeSuer, assignor to The Lubrizol Corp.*

The process of inhibiting corrosion of phosphated metal surfaces which comprises applying to said surfaces a film of product prepared by the process which comprises the reaction of

(a) a zinc salt of a phosphorodithioic acid with

(b) an approximately equivalent amount of an organic epoxide containing at least 4 aliphatic carbon atoms.

Scale Removal

U. S. Patent 2,820,729. *Jan.* 21, 1958. *B. F. Davis, Jr. and P. H. Cardwell, assignors to The Dow Chemical Co.*

A method for the removal of a scale, rich in oxides or hydroxides of ferrous metals, from the surface of a ferrous metal, which method comprises contacting the scale with a stream of a flowable liquid aqueous dispersion of a resin sulfonate, which aqueous dispersion has a pH value of from about 2 to about 7, and which resin sulfonate initially comprises an alkali metal salt of a resin sulfonic acid that is highly swellable by water to the form of a soft, fragile gel and is dispersible by stirring together with water and forms with water an aqueous dispersion that, when of 0.5 weight percent concentration, has a viscosity of from about 100 to about 4,000 centipoises at 25°C., whereby scale is removed from the metal and is dispersed in the liquid, and thereafter removing the ferrous metal and the aqueous resin sulfonate dispersion out of contact with one another.

Phosphate Conversion Coating

U. S. Patent 2,820,731. *Jan.* 21, 1958. *E. Heinzelman, Jr., and S. C. Williamson, assignors to Oakite Products, Inc.*

A phosphate coating bath consisting essentially of an aqueous solution containing, per gallon of water, at least about 0.06 ounce of at least one metal selected from the group consisting of zinc and manganese, said metal being present in the form of a compound at least about 0.07 ounce of at least one anion of an oxidizing compound, phosphoric acid in an amount at least 15% in excess of the amount necessary to react with such metal, and at least 0.0009 ounce of zirconium in the form of a compound in which the zirconium is present in basic form.

Treating Tin Surfaces

U. S. Patent 2,820,474. *Jan.* 21, 1958. *R. I. Frederickson, assignor to Chicago Metallic Mfg. Co.*

In the method for treating tin to develop a permanent heat-absorbing, non-reflecting surface, the steps of electrochemically treating the tin surface while being submerged as the anode in an aqueous electrolytic bath containing 1-5 ounces per gallon of water soluble alkali metal hydroxide and 0.5-5 ounces per gallon of a water soluble chromate and then baking the electrochemically treated tin at a temperature above 300°F. until a uniform drab discoloration is formed over the treated surface.

Electrolytic Stripper

U. S. Patent 2,820,750. *Jan.* 21, 1958. *P. A. Charlesworth.*

A method of anodically removing metal from the surface of a metallic body belonging to the group consisting of iron, nickel, chromium, cobalt and alloys of each, characterized by immersing at least a surface portion of said metallic body in an electrolyte solution containing at least 50% by weight of said solution of acid constituents belonging to the group consisting of sulphuric acid and of a mixture of sulphuric and phosphoric acid, the ratio of sulphuric acid in said mixture to phosphoric acid being greater than 5 to 3, said electrolyte solution also containing between 0.3% and 10% by weight of said solution of an additive belonging to the group consisting of morpholine and morpholine derivatives; and passing current through said metallic body and said electrolyte solution.

Method of Plating

U. S. Patent 2,820,754. *Jan.* 21, 1958. *F. L. Brower, assignor to General Motors Corp.*

Apparatus for electroplating in

which each workpiece is to be subjected to plating for N cycles in a plating tank, which comprises a plating tank having 2N+1 stations, means for moving a plurality of workpieces past said stations, means for immersing alternate ones of said workpieces in the first N stations of said tank and for bypassing the remaining ones of said workpieces from said first N stations, means for immersing the said remaining ones of said workpieces in the last N stations of the plating tank and bypassing the said alternate ones of the workpieces from the last N stations, and means for applying plating current to the workpieces while they are immersed in said tank.

Plating Rack

U. S. Patent 2,820,757. *Jan.* 21, 1958. *W. E. Belke, assignor to Belke Mfg. Co.*

An electroplating rack, comprising a pair of vertically extending metal spines of flat bar shape.

Coating Removal Method

U. S. Patent 2,821,491. *Jan.* 28, 1958. *C. A. Fleming, assignor to Borg-Warner Corp.*

The method of removing a bead from a coated object where the bead is formed of the coating applied to the object and comprising passing the object over and bringing the bead into contact with a rotating roller which is partially immersed in a liquid capable of wetting the surface of the roller and dissolving the coating and rotating the roller at a peripheral speed different from the linear speed of the object such that there is relative movement between the surface of the roller and the object causing a resultant friction therebetween for stripping the bead from the object and the liquid thereafter being effective to dissolve the bead.

Bismuth Plating

U. S. Patent 2,821,505. *Jan.* 28, 1958. *J. G. Beach, assignor to the United States of America*

A process of producing a layer of a binary nickel-bismuth alloy on a metal base comprising immersing the metal base in a nickel sulfate-containing bath, electrolyzing the bath while making the metal base the cathode until a nickel coating of the desired thickness has been obtained, thereafter immersing the nickel-coated base in a solution of an electrolyte mixture consisting essentially of 100 grams of bismuth chloride, 18.5 grams of sodium chloride and 210 milliliters of a 38% hydrochloric acid per liter of solution, electrolyzing the solution while making the nickel-coated base the anode, reversing the current and alternating between cathodic and anodic treatment of the base until a bismuth coating of the desired thickness has been deposited, and alloying the nickel coating and the bismuth coating by diffusion heating.

Paint Brush Guard

U. S. Patent 2,821,734. *Feb.* 4, 1958. *J. J. Carrabine*

A guard and guide device for a paint brush having a handle structure, a support plate pivotally mounted on said handle for lateral swinging movement toward and away from the bristles, means on said support plate for manually swinging the same away from the bristles, means biasing said support plate toward the bristles in opposition to said manual swinging of the support plate, and an oval guard plate.

Sandblasting Tool

U. S. Patent 2,821,814. *Feb.* 4, 1958. *M. E. Fritze, assignor to J. C. Fennelly Co. and D. E. Hilliard*

A tool for sandblasting the interior of pipe and the like.

Silver Reduction Films

U. S. Patent 2,822,289. *Feb.* 4, 1958. *E. H. Millard, Jr., assignor to Olin Mathieson Chemical Corp.*

A method of coating a surface with an adherent film of metallic silver which comprises substantially simultaneously mixing and spraying onto the surface to be coated two aqueous solutions; one solution comprising silver nitrate in a concentration of about 1 to 2.5 percent by weight and the other solution comprising a reducing agent selected from the group consisting of β-hydroxyethylhydrazine and its salts in a concentration of about 1 to 2 per cent by weight; at least one of said solutions containing ammonium hydoxide.

Gas Plating

U. S. Patent 2,822,292. *Feb.* 4, 1958. *H. Schladitz*

Process of depositing a uniform firmly adherent coating of metallic particles of finely divided sub-crystalline size on the surface of a base material, comprising heating a heat decomposable metal compound to a substantially constant temperature exceeding the decomposition temperature of said compound at normal pressures in a confining vessel whereby to develop high pressure substantially exceeding atmospheric pressure and confining the heated compound under sufficient pressure to prevent its decomposition at the elevated temperature, and then explosively releasing the confined vapors in a jet directed against the surface to be coated, the expansive release bringing the metal compound out of the stable condition into the unstable condition, whereby it is decomposed at the discharge of said vessel.

ABSTRACTS

Energy Relationships in Sulfuric Acid Pickling Baths

By W. Mazurzak: *Draht* (Germany), **6**, No. 8, 316-322.

A survey of the energy consumption provides the best criterion for the operation of an electrically heated pickling layout. The relationships are naturally particularly favorable if electric current is available at a reasonable cost. Special factors have to be considered also, such as saving in labor, immediate availability and cleanliness.

A practical basis is studied for the application of electrical heating systems in pickling plant operations and indications are given of the data which must be calculated, with consideration of all the heat consuming factors. This calculation holds good in principle for all energy relationships in open chemical baths for the surface treatment and processing of metals.

A change of the values can occur by the presence of special factors or constructional characteristics such as, for example, vats with edge venting, top covers, under-floor construction and also of radiation to one another of tanks built in proximity. Such layouts require an investigation with consideration of these special factors.

Chemical Polishing of V 2 A Stainless Steel by Gases

H. Steinhausen, Diss. Cologne University, Germany.

The author conducted further investigational work on the already known

fact that V2A stainless steel can be chemically polished with a mixture of NOCl (nitrosyl chloride) and HCl. These gases are previously passed through water. Various polishing ranges were obtained according to the gas composition. Microscope investigations showed that the varying attack is to be ascribed to a varying strong breakdown of grain boundaries and grain surfaces of the metal surface by the polishing gases. A good finish is always associated with a uniform attack and this is the case with a gas composition between 55 to 75 mol. % HCl, 15-40 mol. % NO_2 and 5-1-15 mol. % H_2O.

It was ascertained that the most favorable polishing conditions are 30 minutes at 50°C. Further investigations were devoted to the nitrogen used as the carrier gas for the water vapor and its influence on the polish. In conclusion, the formation of the NOCl gas from HCl and N_2O_4 was investigated.

Copper Plating from Pyrophosphate Baths

H. Benninghoff; *Tech. Mitt.* E. Merck A. G., Germany.

The following covers work conducted in the Neo-Chrome A. G. laboratories at Strasburg. The bath most widely used today contains copper pyrophosphate as an alkaline complex in aqueous solution. The potassium bath has received wider application than the sodium bath, by virtue of the greater solubility of the potassium compounds and the higher transfer number of the potassium ion.

It was found that optimum conditions are achieved with the following composition:

Cu (metal)	22-38 g./l.
Pyrophosphate	150-250 g./l.
Oxalate	15-30 g./l.
Nitrate	5-10 g./l.
Ammonium	1-3 g./l.

The function of the pyrophosphate is to form a highly soluble complex compound with the copper. The pyrophosphate also ensures good anode solubility and serves to improve the conductivity of the electrolyte. The ammonium assists likewise, to obtain a good anode solubility and imparts a pleasing bright color to the copper deposit. The oxalate stabilizes the pH during the electrolysis, imparts a pleasing color to the copper deposit, and assists in producing a silky sheen to the plated metal. The nitrate permits the employment of a higher current density.

The bath formulation can vary within fairly wide limits. The following figures may be regarded as optimum:

pH	8.2-8.8
Ratio P_2O_7/Cu	7.0-8.0
Temperature	50-60°C.
Bath voltage	1.5-4 v.
Current density	1-7.5 amp./dm.^{2}
Current efficiency	100%
Ratio of Anode: Cathode	1:1-2:1

The pH has a great influence on the operation of the bath. If it is too high, the anode solubility rises, if it is too low, the conductivity falls and the stability of the complex salt becomes doubtful.

Coloring Stainless Steels

O. P. Kraemer, *Metallwareninds und Galvanotechnik*, **48**, No. 4, 151-152.

To obtain a dark-blue color, 38 g. lead acetate are dissolved in 500 cc. water. Then 124 g. sodium thiosulfate are dissolved in 500 cc. water. Before use, the two solutions are mixed with one another, and warmed to at least 60°C. The cleaned objects are then immersed and kept in motion. The coloration becomes dark blue and brilliant. It adheres relatively well.

To obtain a black color, the parts are dipped in a bath of molten sodium dichromate at about 400°C, for about 20-30 minutes. After cooling, the ware is rinsed in water and dried. The dry coat has a grayish shade. After dipping in a warm oil bath, the coating becomes a deep black color.

Golden yellow colors can be obtained by immersion in bath consisting of 10 parts sulfuric acid, 5 nitric acid, 1.31 ammonium vanadate and 20 water, for 15-45 minutes at 90°-100°C. Black colors can be obtained by immersion in a bath consisting of 25 parts sulfuric acid, 14 nitric acid, 1.31 vanadates, and 20 water, for 15-45 minutes at 90-100°C.

The electrolytic coloring methods are stated to be superior to the other methods. A suitable electrolyte consists of 25% vol. sulfuric acid; 75% vol. water; 7.5 g./l. sodium dichromate. The bath temperature is 70-95°C., and the current density is 0.06 amp./dm.^{2} at 1-1.3 volts, lead cathodes being used.

On 18-8 chrome-nickel stainless steels the colors obtained in this way range from brown to green.

Another electrolytic method for coloring stainless steel by anodic oxidation is to use a solution of: sodium hydroxide 700 g./l.; potassium permanganate 10 g./l.; sodium sulfide 1 g./l. The bath temperature is 110-120° C., the voltage is below 20, and the color obtained depends on the time, ranging from brown, through purple to black.

Rhodium Plating Practice

E. R. Thews: *Metalloberflaeche*, **10**, No. 3, 85-89.

The author gives full details of the characteristics of rhodium coatings and the techniques of rhodium plating. Details are also given of the processes for thicker rhodium coatings, as well as the possibilities of producing alloyed rhodium coatings.

Interesting details are given of alloyed rhodium plated coatings, which consist of platinum-rhodium alloy deposits with about 90% platinum and 10% rhodium. The bath is made up as follows, to give this alloy plate:

Platinum chloride	12.5 g.
Rhodium chloride	1.5 "
Sodium nitrite	20 "
Distilled water	1 liter

The solution is then heated to 85-90° C. until it has turned a weak-yellow color. An addition of 35 cc. of ammonia is then made. The bath is operated at 7 volts with a cathodic current density of 0.80 to 1.10 amp./dm.^{2}. The bath temperature is maintained at 75-95°C. during plating.

Chemical Oxidation Processes for Aluminum

Metallwarenind. und Galvanotechnik, **47**, No. 6, 264-265.

The chemical oxidation processes which were the forerunners of electrolytic anodizing, are still extensively used where the lower oxide coating thickness is sufficient for the purpose, as is often the case. The process is also useful where an electrolytic oxidation treatment cannot be conducted. The following principles are common to all chemical oxidation processes. The treatment is conducted with aqueous, and generally hot, solutions. As the aluminum reacts with hydrogen ions according to the equation:

$$2Al + 6H^+ \rightarrow 2Al^{+++} + 3H_2$$

it can be assumed that, with almost all these dip processes, decomposition of the water dominates as the oxidation

process. The boundary surface solution/metal becomes alkaline on the metal side. It is now important that the oxidizing agent always freshly contact the metallic base surface. Consequently, materials must be present in the bath which loosen the freshly formed oxide coating and makes a free passage for the solution to the basis metal.

The MBV process is used for pure aluminum and aluminum-magnesium and aluminum-manganese alloys. The baths are as follows:

Sodium carbonate	50 g.
Sodium chromate	15 "
Water	1 liter

or,

Sodium carbonate	65 g.
Sodium dichromate	15 "
Water	1 liter

The bath temperatures for the above two formulations are 95° to 100°C. and the dip time is 5 to 15 minutes.

The oxidized parts subsequently can be colored with dyestuff solutions. An end treatment should always be given, whether colored or in the natural condition. This is the usual pore closing or sealing treatment. This operation is best conducted with 1-3% sodium silicate; at 90°C. for 5-15 minutes. Thorough rinsing should be given between the oxidizing and pore sealing operations with running cold water. After sealing, the ware should be passed through hot water and dried, preferably in warm air stream and not in sawdust.

The EW process has been developed and is applied to the Al-Cu alloys, the bath consisting of:

Sodium carbonate	50 g.
Sodium chromate	15 "
Sodium metasilicate solution 10%	1 "
Water	1 liter

The bath temperature is 90°-95°C. and the dip time is 10-20 minutes. The after-sealing treatment is the same as with the MBV process. The difference between the two treatments is merely that metasilicate is used with the EW process. This serves to modify the somewhat unpleasant grayish-green opaque coloration which is obtained with the MBV process into a colorless transparent form. Fairly extensive variations are available for both processes, both as regards the bath composition and the operating conditions, to conform to any particular aluminum alloy being treated.

Zinc and Cadmium for Corrosion Protection

W. Weigelt: *CEG Berichte*, Duesseldorf, 2 No. 1, 21-25.

It is an extremely difficult matter to find a universal solution to corrosion protective problems and, accordingly, usual practice is to develop a corrosion-protective coating to meet certain special and specified requirements. Corrosion conditions are almost infinite in their variability. Thus, there can be instanced sea water influences, tropical climates, industrial atmospheres, and similar conditions.

The author deals in detail with the corrosion of small building component parts. Tests are described, conducted on such parts in industrial atmospheres, sea climate, and tropical climatic conditions. Test results with pure water are also considered. The important practical conclusion is arrived at as a result of this work that, with the present position of plating technology, cadmium is superior to zinc as a plated coating, in many respects. This conclusion holds good, however, only under certain circumstances, which depend on the nature of the coating. Thus, the coating should be pore-free and should satisfy certain requirements as regards its crystalline condition. Parts produced by electroplating must be well passivated immediately after the plating.

If these conditions are satisfied then, in the majority of applications, a cadmium coating will be found better than a corresponding zinc coating. One has to reckon, however, on a somewhat higher price for the cadmium plating. The corrosion protective value of a zinc plated coating can be made equivalent to a cadmium coating, of course, by increasing the thickness. Broadly, a bright zinc plated coating of 10-12 microns will correspond to the protective value of a cadmium coating of 6-8 microns.

Acceleration of Nickel Plating

S. M. Pantschenkow: *Vestnik Masstro* (Russia), 35, No. 5, 52.

With the normal nickel coating procedures conducted in electroplating practice, the plating operations are generally conducted at current densities of 0.5-1.0 amp./dm.^{2} For the application of a nickel coating 15 microns in thickness, 1.5 to 2 hours are necessary.

An arrangement of movable cathode bars is proposed, by means of which the current density can be raised to 2.5-3.0 amp./dm^2 At the cathode bar, arranged over the nickel plating tank and fastened at the edge of the tank, two arms which point downwards are fixed, in which a second bar is held by a jointed fastening, which provides the racking support for the ware to be nickel plated. A lever is fastened at the end of the upper cathode bar, limited to a certain angle compared with the two arms. This lever is actuated by a second lever rotating at 20-30 r.p.m. until it reaches its maximum upper position. At this point, contact with the second lever ceases and the first lever then swings back by virtue of the weight of the ware hanging on the arms until it is again contacted and actuated by the second lever. Two or more plating tanks can also be operated in parallel by one drive with a cathode rocking mechanism of this type.

Plated Tin-Zinc Alloy Coatings

Galvano Tecnica (Italy), 7, No. 1, 10-21.

Plated tin-zinc alloy coatings show a very good corrosion-protection value. The alloy composition is generally 75-80% Sn and 20-25% Zn. The bath composition is:

Tin (as sodium stannate)	30 g./l.
Zinc (as zinc cyanide)	2.5 g./l.
Total cyanide (as NaCN)	28 g./l.
NaOH	4.6 g./l.

Rubber lined steel tanks are best used. Internal heating coils are provided, for steam or hot water, or immersion heaters can be used. The bath is operated at 65°C. ± 2°. A good exhaust must be provided to take care of the mist.

Oval anodes are used, consisting of 75% tin and 25% zinc. For good, smooth working of the bath it is very important that the anodes should be covered with a film. This anode film must be formed before putting into operation. This is done by hanging all the anodes in the bath and applying 6 volts for 15 seconds. If the anodes show a greenish-yellow film, then the forming is good. The most favorable current density is about 1.6 amp./dm^2. An alloy coating of 0.013 mm. will be deposited with this current density in 33 minutes. The bath control and regulation is very simple.

Energy Relationships in Plating and Metal Finishing Baths

W. Mazurzak: *Draht* (Germany), **6**, No. 7, 278-282.

The planning of large plating and finishing installations, such as continuous ring plating baths, automatic units, continuous pickling lines, heat exchangers, etc., necessitates careful design on the thermal side. A precise calculation is required of the heat requirements with consideration of all the physical factors involved in the heat processes and heat transfer, with due consideration of the practical aspects.

The thermal processes with two baths used for the surface finishing of metals were investigated statistically, these being a nickel plating bath and a pickling bath.

Influence of Electroplating and of Hard Chromium Plating on the Fatigue Resistance of XC 48 Steel

By M. de Leiris. Paper read at the Annual Hard Chromium Plating Conference, Paris, 1957.

The fatigue resistance of hard chromium plated parts has already been studied on an XC 48 S steel, used for shock-absorber shafts and comparable to that used for crankshafts. Cyclic tests of a tensile-compression type were undertaken on test parts which had been subjected to various surface preparation treatments before plating. These surface preparation treatments comprised mechanical finishing with cross-rectification; longitudinal rectification; electropolishing of the surface; hard chromium plating; with and without a low temperature heat treatment.

The following points were observed among the results of these numerous tests. It was found that longitudinal rectification with the mechanical finishing treatment always gives a fatigue strength which is somewhat higher to the transversal rectification treatment; this advantage is retained through all the subsequent treatments.

Electropolishing always increases the tensile-compressive strength whatever the previous mechanical pretreatment. The decrease of the fatigue strength caused by the hard chromium plating is less with electropolishing than with mechanical finishing.

Heat treatment at 160°C. causes a new decrease of the fatigue strength. The best mechanical preparation treatment before plating from the viewpoint of the tensile-compression strength is definitely the longitudinal rectification process and a still further gain is made by completing this mechanical surface preparation by an additional electropolishing treatment before plating.

The Technique of Non-Destructive Metallographic Examination; Application to Hard Chrome Plating

By P. A. Jaquet. Paper read at the Annual Hard Chromium Plating Conference, Paris 1957.

A new technique in non-destructive metallographic examination is described by the author. It consists of substitutions of the original surface by a transparent replica of this in a cellulose varnish and by an arrangement of localized electropolishing termed spot polishing. This technique was developed by the author and serves to reveal the surface characteristics such as microdiscontinuity, microstructure, etc.

Metallographic examinations of this nature were conducted on hard chromium deposits. By way of example, the author compared surface aspects of chromium deposits of a thickness of 25 to 30 microns on steel which had been finished mechanically and which had been electropolished. For parts which are subjected to a rubbing action under service conditions, electropolishing before plating resulted in better adhesion.

These various micrographic observations were also shown to be in agreement with the respective behaviors in service of the various deposits of hard chromium plate obtained. The author, incidentally, made a number of remarks on the structure of hard chromium deposits in association with the nature of the state of the surface of the basis metal.

Some Notions of the Influence of Hard Chromium Plating on the Fatigue Limit of Engineering Parts

By V. Linhart and J. Sulc. Paper read at Annual Hard Chromium Plate Conference, 1957.

This paper, which covered work conducted in Czechoslovakia, gives details of considerable research work. The authors first studied the internal stresses of chromium deposits as a function of the compositions of plating baths, notably as a function of the sulfuric acid content and of the plating conditions. Thus, they were able to determine as the optimum condition:

CrO_3 — 150 g./l.
H_2SO_4 — 3 g./l.
Temperature: 50°C.
Current density: 40-80 amp./dm.^{2}

The results of the fatigue tests served to show that the reduction of the fatigue limit due to hard chromium plating is a minimum when the tensile stresses in the deposit disappear or are transformed into compressive stresses.

The authors then studied the effects on the fatigue limit of shot peening and of rumbling of the basis steel surface prior to plating. In this way they demonstrated that these two treatments could almost totally suppress the lowering of the fatigue limit caused by plating.

Influence of the Impurities of Bright Nickel Plating Baths on the Throwing Power of Chromium Plating Baths

By R. and G. Rousselot. Paper read at the Annual Hard Chromium Plating Conference, Paris 1957.

The metallic and organic impurities of nickel plating baths cause an alteration of the nickel deposit at the zones of low current density. However, it is precisely in these zones that will be situated the lower limit (throwing power) of the subsequent deposit of chromium plate. The impurities of the nickel plating bath, accordingly, have an effect on the throwing power of the chromium plating bath.

The authors limited their research work in this case to the metallic impurities, studying the effect of copper, zinc, iron, chromium, lead, tin, cadmium, and molybdenum.

Among other conclusions the authors were able to note:

1. With the exception of chromium and, to a lesser degree, with zinc, cadmium, and molybdenum, which give a rapid elevation, the majority of the metallic impurities only give a low and progressive increase of the covering power.

2. The nickel deposit is visibly altered before the impurity causes a sensible increase of the covering power.

3. Every increase of the covering power of the chromium plating bath without modification of the nickel can be attributed to an organic contamination.

Recent Developments

NEW METHODS, MATERIALS AND EQUIPMENT FOR THE METAL FINISHING INDUSTRIES

Rod Insulator

Davies Supply & Mfg. Co., Dept. MF, 4160 Meramec St., St. Louis 16, Mo.

A new type of electrode rod insulator of single-bolt construction is known as the "Uni-Bolt." The one-piece insulator is available in a variety of sizes. It is constructed of heavy steel, with stainless steel bolt, and is covered with a heavy coating of plastisol. Unique design provides automatic insulation, with no spacer required. The insulator can be used on tanks for alkaline, acid and oxidizing solutions, and is completely resistant to liquid absorption.

Electroless Process for Nickel Plating Magnesium

Dow Chem. Co., Dept. MF, Midland, Mich.

A new electroless process for nickel plating is unlike previously-developed processes, in that it can be used to plate magnesium as well as other metals, including steel, aluminum and copper. Earlier processes worked with other metals but not with magnesium because they were based on hydrochloric acid, which attacks magnesium.

Good hardness and uniform coating are features that should make the process advantageous for plating magnesium printing cylinders and plates. Electroless nickel plates uniformly over both raised and low areas and does not build up on sharp corners, thus preserving the plate or cylinder's original detail.

The new process starts with surface conditioning of the metal by degreasing or other method, followed by chemical etching. Next, the metal is defilmed, then is immersed in the nickel-plating bath for the prescribed period. Each step is followed by a water rinse.

Zinc immersion plus copper strike, a necessary step in the magnesium nickel electroplating process, is used with the electroless process only if maximum corrosion protection is required.

Reverse Current Cleaner

Oakite Products, Inc., Dept. MF, 19 Rector St., New York 6, N. Y.

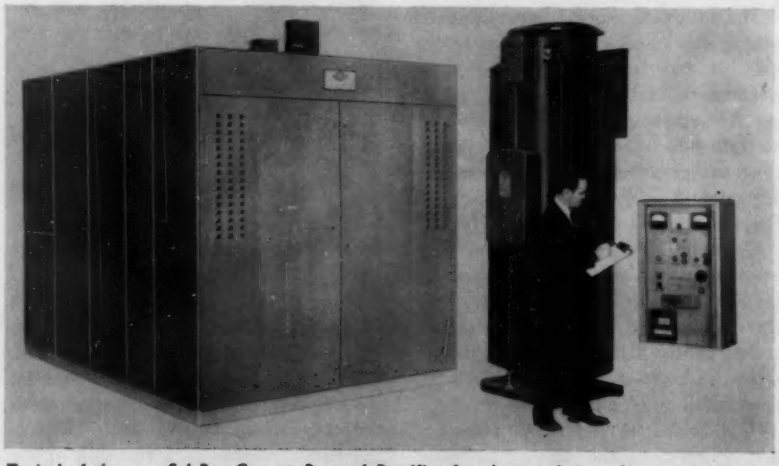
Composition No. 190, a new reverse current cleaner, is slated to provide greater conductivity and surface activity than was previously available in a single electrocleaning material. It is particularly effective in cleaning heavily smutted steel. It also removes fingerprints, light surface rust and oxides resulting from spot or seam welding. The material is used at concentrations from 8 to 16 ounces per gallon of water, at temperatures ranging from 180° to 200°F., with reverse current, from 40 to 100 amp./ft.^{2} It may be used with or without a precleaner. It rinses well in hot or cold water.

Polarity Reversing Rectifier

Sel-Rex Corp., Dept. MF, Nutley, N. J.

A revolutionary method of combining different semiconductor elements has led to the development of the first rectifier which permits reverse current etch prior to chromium plating, in high amperage ratings, it is claimed. The new rectifier permits output polarity reversal on units up to 10,000 amperes, by means of a panel mounted switch, or a push-button operated, solenoid controlled air device.

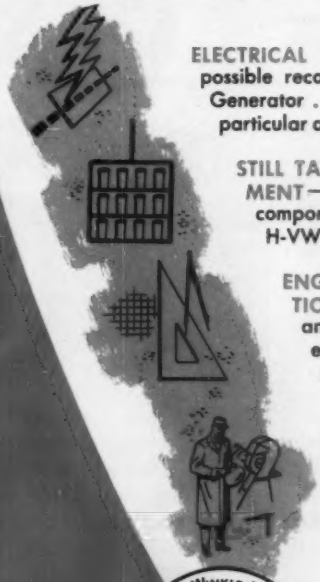
Among the advantages claimed for the new rectifiers, as compared to equipment previously required for the application, are: up to 50% lower initial expenditure; simplified, less expensive installation; occupies much less floor space; static operation — no moving parts to wear and get out of alignment.



Typical of the new Sel-Rex Current Reversal Rectifier for chrome plating, this unit is rated at 10,000 amperes at 12 volts, and features remote controls and induction regulator.

Aluminum
anodizing, buffing and cleaning

No matter what your aluminum finishing problem or need, you'll find the answer at H-VW-M... because it is the one company combining a complete engineering service with a complete line of equipment and supplies!



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ENGINEERING SERVICE AND INSTALLATION — H-VW-M engineers and technicians are anodizing equipment specialists, with years of experience. Page 3 tells why these H-VW-M services mean greater efficiency and savings in your plant.

ALUMINUM FINISHING SUPPLIES — Page 4 shows how H-VW-M research has resulted in new compounds, improved buffs and cleaners to make aluminum finishing easier, better.

HANSON-VAN WINKLE-MUNNING CO. · MATAWAN, NEW JERSEY, U.S.A.

HANSON-VAN WINKLE-MUNNING COMPANY
MATAWAN, NEW JERSEY

Manufacturers of a complete line of electroplating and polishing processes, equipment and supplies

PLANTS: Matawan, N. J. • Grand Rapids, Michigan • Los Angeles, California (Alert Supply Co.)

Sales Offices: Anderson (Ind.) • Baltimore • Beloit (Wisc.) • Chicago • Cleveland • Dayton Detroit • Grand Rapids • Los Angeles (Alert Supply Co.) • Louisville • Matawan • Milwaukee New York • Philadelphia • Pittsburgh • Plainfield (N. J.) • Rochester • San Francisco (Alert Supply Co.) • Stratford • Toledo • Utica • Wallingford (Conn.) • West Springfield (Mass.)

These H-VW-M Anodizing and Finishing to New Savings, New Efficiency, New

ELECTRICAL EQUIPMENT

H-VW-M is the only manufacturer of both Germanium and Selenium Rectifiers *and* low voltage, direct current Motor Generator Sets for the metal finishing industry. This thorough experience in every phase of low voltage power generation and rectification means that when you bring your power problems to H-VW-M you're sure to get the perfect equipment recommendation.

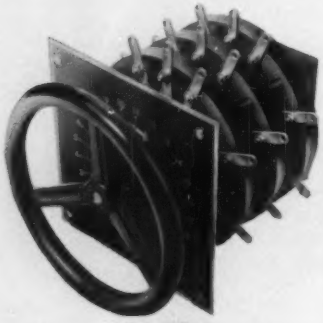
Self-Contained Rectifier with Tap Switch Control

Remote Controlled Rectifier with Tap Switch Control

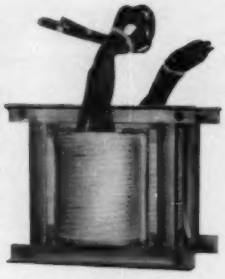
Germanium and Selenium Rectifiers . . . Rectifier Controls

Highest quality and efficiency, flexibility, economy and low maintenance are the characteristics combined in H-VW-M's full line of both Germanium and Selenium Rectifiers. 6 to 48 volt units—both remote and self-contained—provide the exact direct current low-voltage and high amperage required in aluminum anodizing. The widest possible choice of controls and control combinations is available. Such devices as manual or motor operated tap switch controls, continuously variable auto-transformers and saturable core reactors are used with or without supplemental controls to provide automatic voltage stabilization, automatic constant current as well as automatic programming.

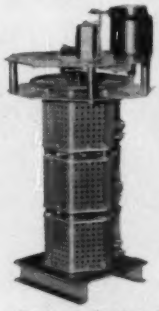
Write for Bulletin ER-108, which gives further information about Rectifiers and Controls, plus useful control application suggestions.



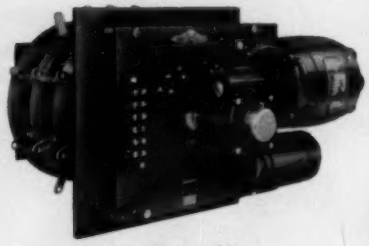
Manual Tap Switch Control



Saturable Core Reactor



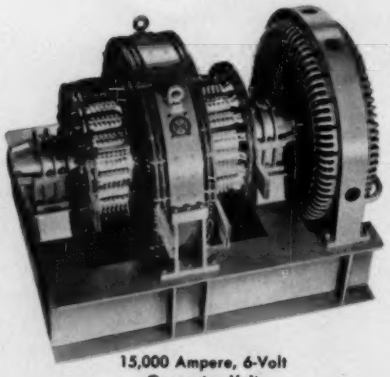
Continuously Variable Auto-Transformer



Motor Operated Tap Switch Control

Generators . . . and Controls

H-VW-M Motor Generators designed especially for metal finishing operations are built in sizes up to 50,000 amperes, and accessory equipment includes a full line of controls and control panels to cover any desired control function. Easy-to-maintain H-VW-M Motor Generators have exceptionally rugged and practical construction features insuring maximum performance and life. Standard voltage ratings range from 6 to 50 volts, and include the 18 and 24 volt units usually required for sulphuric acid anodizing, plus the 40 and 50 volt units used in chromic acid anodizing. Write today for 24-page Bulletin G-104, covering in detail all H-VW-M Generators.



15,000 Ampere, 6-Volt Generator Unit

Automatic Anodizing Control Panel

Supplies, Equipment and Services Add Up Simplicity of Operation in Your Plant

PROCESSING EQUIPMENT

Whatever your anodizing procedure, there's an H-VW-M Full Automatic Conveyor that can be adapted to any production application requiring automatic cycling of individual treatments – or an H-VW-M Tank with accessory equipment that is perfectly adapted to still tank methods of any kind.

Workman "dials" desired cycle in refrigerator plant. Parts will by-pass or lower into baths as dial setting dictates.

Automation in Metalfinishing— *Full Automatic Conveyors with Dial-A-Cycle*

H-VW-M's new DIAL-A-CYCLE system automates nine or more complete metalfinishing processes on a single anodizing or electroplating machine. This revolutionary by-pass mechanism can be used on any metalfinishing installation for anodizing, electroplating, or similar processing. It is especially useful and effects substantial cost reductions when a variety of parts requires several different processes or colors.

DIAL-A-CYCLE, as the name implies, is controlled by a simple dial setting. The dial is mounted on the carrier arm that carries the parts through processing tanks. It is set by the machine operator for the processing steps through which each load of unfinished parts is to move. Automatic conveying then takes over, lowering the parts into the required tanks and bypassing others.

Different products, requiring different anodizing cycles, may be processed at the same time, with the same equipment. DIAL-A-CYCLE gives you new versatility while reducing operating, labor, and maintenance costs. Close, automatic control of transfer and immersion periods improves quality.

DIAL-A-CYCLE is the newest of many types of conveyors and equipment H-VW-M supplies to aluminum finishers. H-VW-M also designs, manufactures, and installs return-type conveyors . . . elevator conveyors . . . straight-line conveyors . . . and others. For a complete description of all types, write for Bulletin FA-105.

Tanks and Equipment

At H-VW-M – the plating and anodizing industry's workshop—you'll find tank equipment for every phase of your work. For chromic acid anodizing, H-VW-M double electric welded unlined steel tanks are offered, along with steel coil equipment for cooling and heating. The entire system is H-VW-M designed, supplied and installed. For sulphuric acid anodizing, lead-lined steel tanks, plus the necessary cooling coils and air agitation assembly, are supplied. Tanks are fabricated from hot rolled steel, stainless steel, and aluminum. Other types of tanks are also available. Bulletin No. T-108 gives full particulars about this important H-VW-M equipment. Every conceivable type of auxiliary equipment is engineered and supplied, according to customers specifications, including a complete packaged refrigeration system for anodizing solutions.

And H-VW-M's Engineering and Installation Service

Anodizing problems of *any* kind? H-VW-M is prepared to set up your entire anodizing system from beginning to end—a system made up of components scientifically engineered to work together with utmost efficiency. Because of this, and because of H-VW-M's continuing research and development in every aspect of the anodizing picture, you can be confident that the recommendation you receive from H-VW-M is the very *best*.

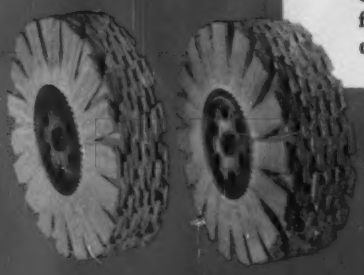
What's more, if requested, H-VW-M sees to it that the equipment you buy is H-VW-M *installed*. This means perfect, efficient operation from the start.

Add to this the fact that an H-VW-M technical representative—ready to serve you—is no further than your telephone. These representatives serve in principal cities across the nation. Get to know the one nearest you. He can help you get the most from your aluminum finishing equipment and supplies.

TURN THE PAGE FOR ALUMINUM BUFFING AND CLEANING SUPPLIES

ALUMINUM BUFFING AND CLEANING SUPPLIES

Since aluminum came into its own after World War II, considerable H-VW-M research and development work has been devoted to the perfection of buffs and compounds suiting the unique physical characteristics of this popular light metal. When long-wearing H-VW-M Buffs are used in conjunction with H-VW-M compounds especially formulated for aluminum finishing, you have the perfectly balanced combination for economy, efficiency and quality performance.

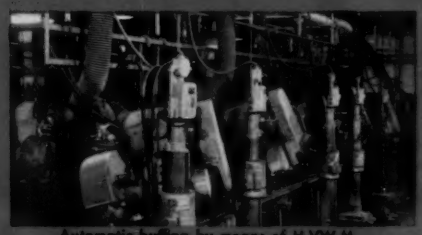


Buffs

Nowhere will you find a wider selection of the buffs you need for preanodizing operations than at H-VW-M. Whether you're looking for a super-heavy-duty buff like new steel-centered Ruff-L-Buffs (which are available untreated, or Binderized® for extra long wear) medium duty buffs like Triplex Buffs, or a buff for medium-to-light service such as the Full Disc Buff, you need look no further than H-VW-M. The full H-VW-M line also includes new Tufta-Flex Buffs (cloth tufts) and Sisal-Flex Buffs (with sisal-centered tufts).

Among this array you'll find the exact buffs for your aluminum finishing needs. Every one is characterized by first quality, uniform new material of close weave and good weight . . . tight sewing with heavy thread . . . and proper balance. Write for 12 page Bulletin B-103, which describes H-VW-M's entire buff line.

Hand buffing using H-VW-M buffs, compounds.



Automatic buffing by means of H-VW-M Liquimatic System.

Compounds

For heavy duty cutting, H-VW-M Liquid Tripoli Compounds 303 and 420 were developed, and are now widely used in the cooking utensil industry. For the appliance, storm window, construction materials and automotive fields, H-VW-M's new Liquimatic Liquid Compound No. 728 has proved especially successful, giving excellent cut, while leaving the surface with deep, high color.

H-VW-M Bar Compounds also find broad use in aluminum finishing. A variety of tripoli bar compounds are offered in varying consistencies to meet all cutting requirements. For cut and color, special white compounds are available. And for high color, several new H-VW-M aluminum oxide compounds—No.'s 6-B-168, 6-B-72 and 8390—give unusually good results. Write for Bulletin CO-103.

Cleaners

H-VW-M devotes constant research to the subject of cleaners in its search for ever better products in the aluminum finishing field.

Matawan Cleaners are designed specifically to give superior results in soak cleaning, power spray operations, oxide removal, and for special aluminum cleaning and etching operations. Of particular interest is H-VW-M's 858 Cleaner, which prevents scale formation, thus keeping coil and tank walls scale free. This unusual aluminum cleaner leaves an extremely bright surface, and, because of its built-in regenerator, makes maximum effective use of caustic in the bath.

In line with its desire to supply the exact cleaner for the job, H-VW-M offers its extensive laboratory facilities where circumstances demand a special cleaner.

When you think of aluminum finishing equipment and supplies—think of H-VW-M first. Buying from one dependable source . . . H-VW-M . . . means one company assumes full responsibility—your guarantee that you're getting the best . . . in products . . . in performance, in *extra* service.

PLATEMANSHIP

Your H-VW-M combination—of the most modern testing and development laboratory—of over 80 years experience in every phase of plating and polishing—of a complete equipment, process and supply line for every need.

HANSON-VAN WINKLE-MUNNING COMPANY, MATAWAN, N. J.
Plants: Matawan, N. J.• Grand Rapids, Michigan
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H-VW-M

INDUSTRY'S WORKSHOP FOR THE FINEST IN PLATING AND POLISHING PROCESSES • EQUIPMENT • SUPPLIES

4758

Printed in U.S.A.

Automatic Spray Gun

Nordson Corp., Dept. MF, Amherst, Ohio.

Available to all users of the above manufacturer's airless spray and hydraulic spray painting equipment, is the new AG-100-B automatic spray gun, which provides the following distinct features.

Designed to operate at speeds up to 3,000 cycles per minute, this gun employs frictionless seals.

The unique design eliminates needle packings completely. Instead, the needle floats in the material being sprayed and is controlled by a finger which operates within a Teflon boot.

Cup leathers and rubbers have been eliminated and instead the small air cylinder which triggers the gun is designed around a trouble-free frictionless diaphragm.

Both paint hoses as well as the trigger-air hose are located at the rear of the gun.

The specially designed carbide needle and seat of the gun will withstand millions of cycles even on materials such as red iron oxides.

The AG-gun weighs less than two pounds; considerably less than the automatic guns formerly used for airless spray coating.

Cadmium Bright Dip

Heatbath Corp., Dept. MF, Springfield 1, Mass.

Two new chromate products are used to produce a clear bright finish on cadmium plate with complete freedom from iridescence. Leaching is not required. Working solutions are made up using only 3½ ounces of #27 per gallon resulting in a very low cost operation. Duracoat 27 and 27L are supplied as powder or liquid, depending upon the customer's preference.

Chromate Conversion Coatings

Kosmos Electro-Finishing Research, Inc., Dept. MF, P. O. Box 217, Hackensack, N. J.

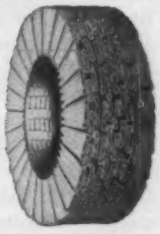
Ker-chro-Mite P has been developed for clear or olive drab chromate finish on both zinc and cadmium plate. The product is shipped in solid form in non-returnable containers. A very thin deposit is required for maximum protection, and it is an excellent base for paint. Lowest cost per unit area treated is claimed.

Treated Buffs

American Buff Co., Dept. MF, 2414 S. La Salle St., Chicago 16, Ill.

The result of four years of research and experiment, a new scientific development, called the "Golden Treatment," is claimed to have proven its benefits on all types of cotton and sisal buffs manufactured by the above firm. Easily recognized by its golden tinge, it brings three outstanding advantages to the trade.

By strengthening and binding fibers together, the treatment adds firmer body, prevents fraying. Particularly on sisal buffs, this treatment is stated to



provide smoother, stronger fibers and extra stamina without extra stiffness. Sisal cloth which has had this treatment retains buffing compound better, prevents compound waste and makes a more effective buff. In both cotton and sisal, firmer body gives harder, faster cutting action, non-fraying, scratch-free, no-streak finishing. Ability to retain buffing compound (which adheres to the slightly adhesive surface) permits better finishing in fewer passes. More output per hour and longer life per buff are important additions to the profit side of the ledger.

The treatment is available on bias cloth, unit cloth (sewed and unsewed), pleated cloth, bias sisal, open bias sisal and unit sisal buffs, in patented centerless or permanent center types . . . in "soft" for contour work, "hard" for flat-surface buffing.

Aluminum Bright Dip

Conversion Chem. Co., Dept. MF., 98 E. Main St., Rockville, Conn.

The greatest advantage of two new non-fuming aluminum bright dips known as Kenvert #46-A and #46-L, is the elimination of corrosive brown nitrogen oxide fumes from the bath and work in transfer. The bath is claimed to be more stable for weekend shutdown or when not in use.

Savings result from less acid consumption, reduced expense for exhaust and ducting systems, and more efficient working conditions. There is less sludging, reduced pitting with this safe, easy-to-use, powder.

#46-L is stated to be the only bright, bright non-fuming dip for Lurium grade aluminum and its alloys.

Strippable Protective Coating

Guard Coatings Corp., Dept. MF, 8-05 43rd Ave., Long Island City 1, N. Y.

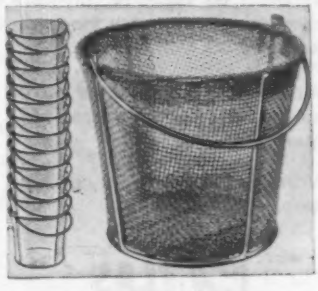
Metalguards S-5119 and S-5219 are plastic solutions in organic solvents which on air drying form tough, flexible and strippable films. These films have outstanding resistance to degradation when exposed for long periods to all extremes of weather and, having excellent abrasion resistance, they act as barriers to and are not attacked by water, moisture, chemicals and chemical fumes. These films remain easily strippable for more than one year when applied at recommended film thickness.

Dipping Baskets That Nest

Belke Mfg. Co., Dept. MF, 946 N. Cicero Ave., Chicago 51, Ill.

Prolonged basket life with new freedom from cluttered up floors are improvements afforded by new tapered dipping baskets.

The basket illustrated is 11 inches high; 12 inches at the top and 10 inches at the bottom, inside diameter. A dozen of these baskets nest in a



stack only 36 inches high, making it easy to keep baskets off the floor and protected from traffic and rough handling when not in use.

Atlas

INDUSTRIAL FLOORS STOP CORROSION

. . . in pickling and plating rooms!

Atlas Industrial Floors in your pickling and plating rooms will permanently stop corrosive attack . . . not merely retard or control it. They are resistant to the widest range and concentrations of acids, alkalies, salts and solvents.

These floors are constructed of acid brick laid on an impervious membrane and joined with Atlas corrosion-proof cement. There is a wide choice of cements available . . . each to solve a specific problem.

Atlas floors are engineered to withstand all types of physical abuse from heavy static loads to constant truck traffic.

Make an Atlas Floor your permanent corrosion-proof base for operations.

Write for Bulletin 3-3 giving complete details.

ATLAS MINERAL
MERTZTOWN, PENNSYLVANIA

Bright Copper Plating Processes

Harshaw Chem. Co., Dept. MF, 1945 *E. 97th St., Cleveland 6, Ohio.*

Cynorex is a new high speed copper cyanide bath which produces a bright and ductile copper by the use of a single addition agent designated as Cynorex No. 1. The process has many advantages including unusual brightness; a smooth fine grain and ductile deposit; stability; high efficiency; economical operation; and high tolerance to metallic impurities. The process can also be operated with air agitation.

The process is easy to maintain and operate because it has only one brightening addition agent, a non-metallic agent which is very stable and is not removed by carbon. Cathode and anode current efficiencies of the bath are 100%. Because of the stability of the single brightening addition agent, the bath will produce satisfactory bright deposits even after extremely long periods of shutdown. A compatible wetting agent is available where operating conditions dictate its use.

Among the advantages of Cuprex acid copper are its superior brightness, excellent leveling, ductility, and stability. The bath can be operated not only as a still or cathode rod agitated solution but also with air agitation. Another distinctive advantage of this process when operated still or with cathode rod agitation is that a cyanide copper strike is not required for adhesion of the copper to the basis metal. As an air agitated solution the normal copper or nickel strike is required. The bath has indefinite operational life and, therefore, the problem of treatment cleanups is at a minimum.

The bright throwing power of the bath is claimed to be superior to any competitive acid copper plating solution. The deposit is the most easy to buff of any acid copper plate because of its great leveling and hiding power. Nodular buildup in all instances is characteristically at a minimum.

The process yields a deposit having a high ductility thru the entire range of conditions and compositions used to vary the deposit from an excellent semi-bright to the fully bright appearance.

Metal Finishing Process

Roto-Finish Co., Dept. MF, Kalamazoo, Mich.

Cor-A-Brite is a new metal finishing process which produces a bright, lustrous finish on high alloy steels. One of its outstanding advantages is that the entire process is completed with one chip mass in one standard barrel finishing machine. This obviates handling parts between several different operations and assures uniformity in appearance and finish of the work pieces. Tests indicate that the quality of results obtained is in direct relation to the quality of the steel being finished.

High alloy steel bearings, illustrated in the accompanying photograph, can be processed to produce a bright surface with a microinch reading of 2 rms. When this part comes from the grinders, it has an rms of 10 microinches. In a 10-hour finishing cycle, the microinch reading will be reduced to 2 rms in a single conventional Roto-Finish machine with loads up to 350 lbs.

Stainless steel stampings can be polished to a high degree in a relatively short time cycle. Any die marks present from the stamping will be removed or blended into the surface through the natural, uniform grinding action of the process. The process is claimed to produce a better surface on hardened steels than on unhardened steels of the same alloy.

Peelable Plastic Coating

Harco Chemical Co., Dept. MF, Cranford, N. J.

Peel-It Weatherguard is a liquid plastic applied by spraying or dipping on any non-porous material such as machinery, tools, dies, metal stocks, etc. The dry film, which is non-flammable, is a moisture barrier. The coated objects are protected against corrosive effects of chemicals and chemical fumes, extreme weather conditions in outside storage and abrasion.

The protected object can be restored to use immediately without further cleaning or preparation by simply stripping or peeling off the plastic coating. There is no oily residue or any type of contamination.

Field tests have shown the coating will last up to three years (according to thickness of original coat).

Neutral Trichlorethylene

Dow Chemical Co., Dept. MF, Midland, Mich.

A neutral type of trichloroethylene now rounds out the company's industrial solvents line to include four vapor degreasing chemicals and two cold solvents.

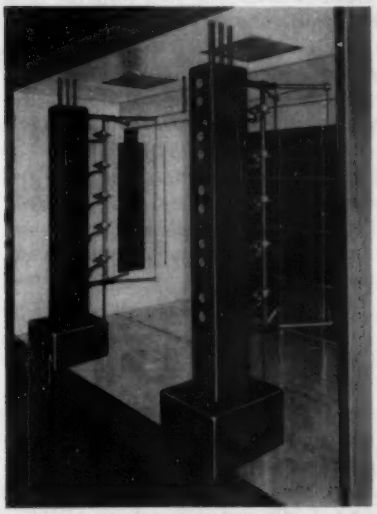
A new series of trademark names for its trichloroeythlene types has also been adopted. The new type will be designated Neu-Tri. Other types available and their new designations include Hi-Tri, a high purity trichloroethylene; Alk-Tri, an alkaline stabilized trichloroeythlene; and Ex-Tri, a trichloroeythlene designed expressly for extraction application.

The solvent is tailored for use in vapor degreasing operations which require a neutral rather than an alkaline type of trichloroethylene. It meets all military specifications pertaining to vapor degreasing grades of trichloroeythlene.

Electrostatic Spray Systems

Binks Mfg. Co., Dept. MF, 3122 Carroll Ave., Chicago, Ill.

In this compact, modular electrostatic spraying system, paint leaves an automatic air atomizing spray gun and receives a negative electrical charge. The metal object being painted is electrically grounded. Because of this positive-negative condition, the product acts as a magnet for the paint. This power-



Two, five spray gun stations in a regular filter dry type spray booth demonstrate the flexibility of Binks modular electrostatic spraying system. Any number of spray guns, depending on product specifications or production needs, may be mounted on the modular station.

MURRAY WAY "PROVED RIGHT" EQUIPMENT AND ENGINEERING EXPERIENCE ARE THE ANSWER TO YOUR POLISHING, BUFFING AND GRINDING NEEDS.
Whether you need a single, standard polishing head or a specially engineered, fully automatic production line with all the trimmings, Murray-Way can do the job better, more reliably, for greater operating efficiency.
You are invited to consult our engineering staff about your finishing problems.
MURRAY WAY CORPORATION
P. O. BOX 180, MAPLE ROAD EAST, BIRMINGHAM, MICH.
Polishing, Buffing, Grinding, Filtering Equipment that automatically cuts your costs.

Pure dependability
for metal cleaning
DETREX
PERM-A-CLOR NA*
(Trichlorethylene)
Only DETREX, with experience and facilities unmatched in the metal cleaning industry, could have produced PERM-A-CLOR NA. Setting new standards in stabilization, this ultra efficient, superior solvent is another example of Detrex leadership in metal cleaning materials, methods, equipment and technical research and field service.
* * *
Depend on DETREX for Every Metal Cleaning and Processing Need
PERM-A-CLOR NA (Degreasing Solvent)
Solvent Degreasers
Ultrasonic Equipment
Industrial Washers
Phosphate Coatings and Paint Bond Compounds
Rust Proofing Oils and Compounds
Alkali and Emulsion Cleaners
Extrusion and Drawing Compounds
Spray Booth Compounds
Aluminum Finishing Compounds
*PERM-A-CLOR (NA) IS REGISTERED TRADEMARK OF
DETREX CHEMICAL INDUSTRIES, INC.
BOX 501, DEPT. MF-7, DETROIT 32, MICHIGAN

ful product-paint attraction assures maximum coverage and utilization. The system is applicable to the painting of metallic products that can be handled on overhead conveyors or base-mounted conveyorized spindles. In addition to other efficiencies, overspray is greatly reduced, lowering finishing costs. Reduced overspray in turn cuts down on spray booth cleanup time.

The equipment is housed in modular, self contained packages. Within each package are fluid and air pressure controls with regulator valves and necessary hoses. Neatly arranged in instrument panel style at the rear of the case are the fluid and air pressure gauges and a spray gun test button with which the operator can test actuate any single gun for spray pattern without disengaging other spray guns in the system.

The modular units may be stacked and clamped one on the other depending on product measurement or variety of shape. Additional stations of modular units may be added as production rates increase. The neatly packaged stations offer no interference with each other and require only a single air gun control, material, and high voltage connection regardless of how many guns in the station.

Standard Model 21 automatically triggered spray guns are mounted on a vertical plated rod which is supported by two Y-shaped yokes, one above and one below the spray gun. Each gun is completely adjustable up or down, right or left on the vertical rod. Two stand-off insulating rods form the arms of the Y yoke and support the electrostatic grid about 12 inches out from the spray gun nozzle. The grid provides maximum point surface for effective corona discharge.

Each modular unit has a $7\frac{1}{2}$ x 9 inch access door to facilitate setting of material and air pressures. However, self-contained controls within each unit discourages casual tampering with optimum settings.

The units can be easily operated by any painter who is familiar with the operation of standard equipment. In the event production demands a return to hand operated spray painting techniques, it is a simple matter to pull the entire assembly out of the booth and set it aside until it is needed again. All parts in the system are standardized.

The systems operate on 100,000 volts at 5 ma. maximum. The entire electrical system, power transmission and supply, is interlocked for safety and

will automatically cut off in case a grounded object comes too close to the electrostatic grids.

Stripper for Epoxy Coatings

Enthone, Inc., Dept. MF, 442 Elm St., New Haven, Conn.

A non-flammable, cold solvent stripper for epoxy enamels, known as Enamel Stripper S-16, is designed to strip many of the newer epoxy resins which are usually very difficult to remove.

The product is very easy to use. The items being stripped are merely immersed in the undiluted stripper at room temperature. The epoxy enamel is rapidly wrinkled and detached from the basis metal, whereupon it falls to the bottom of the stripping tank or may be flushed off in a subsequent cold water rinse. There is no attack of most commonly used basis metals such as steel, aluminum, copper, and brass in the short times usually required for complete stripping.

The stripping solution can be readily maintained by periodic additions. Since the coating is not dissolved by the stripper, the stripper does not deteriorate due to buildup of dissolved enamel and, therefore, has long life.

Aluminum Cleaner

Parke-Hill Chem. Corp., Dept. MF, 29 Bertel Ave., Mount Vernon, N. Y.

Alumi-Brite is a new aluminum cleaning compound, formulated with a mild acid to remove oxidation, dirt, grease, grime, light oil, and carbon from aluminum without danger of etching the metal.

Applied with a brush or rag, it combines acid action with detergent action to remove even stubborn grease and grime from aluminum surfaces. Allowed to remain in contact with the surface to be cleaned for a few minutes, reapplied and then hosed off with water, it may be reapplied in the same manner.

Silicon Plating Rectifiers

Rectifier Dept., General Electric Co., Dept. MF, Schenectady 5, N. Y.

Design of a new silicon plating rectifier with automatic current density control has been announced by the above manufacturer.

The automatic current density control on this new silicon rectifier provides precise voltage and current whether one lightly-loaded rack or

Stokes Vacuum Coater cuts finishing costs

New England Metallizing Co., Pawtucket, R. I., uses a Stokes Model 437 Vacuum Metallizer for the production of trophies, costume jewelry and other products. Michael Corso, Jr., President, says—"Because of the ease of operation, ease of maintenance, and speedy pumpdown, we would recommend the Stokes Metallizer to anyone in the metallizing field." Its design enables easy cleaning—its big capacity gives maximum production.

Stokes vacuum metallizing imparts a distinctive gold, brass, copper or chrome finish at attractively lower costs than electroplating . . . makes it possible to offer smart, modern products at low, competitive prices. It enables plating non-conductive materials—provides bright lasting finishes that will withstand weather and other abusive environments.

Interlocked centralized controls on the Stokes systems make it easy to learn operating procedures and routine—to meet consistently high standards with minimum labor. The equipment is compact and self-contained . . . requires little floor space.

Stokes can give you practical help in over-all planning . . . to determine plant layout, production techniques, rates, and costs . . . to select materials and auxiliary equipment . . . to train operators. Contact your nearest Stokes office, or write for data on Stokes Vacuum Metallizing equipment.

Vacuum Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

STOKES

many fully-loaded racks are being run. Basically, this control is made possible by taking a current signal from the rectifier output and using this signal to adjust the output voltage for compensation on very light loads. Despite the addition of this important control, there is no increase in the price of the equipment.

Silicon cells, with their higher overload capacity, greatly reduce danger from harmful current surges. Engineering tests have shown the new plating rectifiers can withstand surges of up to 50 per cent over rated current without cell failures. With this equipment, platers can operate at higher ambient temperatures (up to 113°F) without any derating.

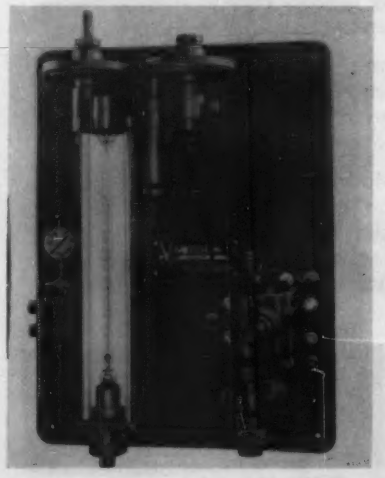
Other new features of this equipment include new Class B glass insulation on reactor and transformer, over-current protection, and new shipment-tested structural strength. Addition of a remote control unit makes possible regulation of automatic current density, constant current, constant voltage, and automatic anodizing.

Chlorinator

Wallace & Tiernan Inc., Dept. MF, 25 Main St., Belleville 9, N. J.

A new V-notch chlorinator for low-capacity installations, Series A-741, is wall-panel mounted, requiring no floor space. No auxiliary water or drains are required, a V-notch variable-orifice gives precise and smooth feed-rate adjustment, and all parts are made of corrosion-resistant plastic, molded for interchangeability.

Vacuum operation gives protection against chlorine leaks. The addition of simple auxiliary apparatus, which interupts the water supply, provides semi-automatic operation of this economical chlorinator.

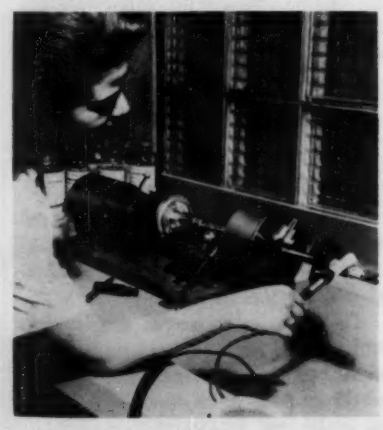


The chlorinator is ideal for plants which require a low-capacity, inexpensive unit to treat a uniform continuous or interrupted flow.

Turning Heads for Easier Selective Plating

Dalic Metachemical Ltd., Dept. MF, 121 Judge Road, Toronto 18, Ont., Canada.

To simplify Dalic plating of circular or cylindrical components, a special low-speed turning head is now available as an optional accessory. The turning head includes a variable speed control, for infinite adjustment of rotation from zero to 400 rpm., in either direction. Therefore, the correct tool-



Newspaper gets a dividend of 8 rotogravure rolls for each tankload of "Plus-4" Copper Anodes

A litt'e over a year ago, the *St. Louis Post-Dispatch* first tried "Plus-4" Phosphorized Copper Anodes for acid-copper electroplating rotogravure rolls. J. Snyder, roto-engraving superintendent, and A. T. Primm, production manager, report they have averaged eight extra rolls for each tankload of "Plus-4" Anodes

15% SAVING over-all in plating operations are estimated as a result of the following cost-cutting advantages:

1. More copper per anode plated on the rolls.
2. Considerably less scrap.
3. Reduced use of chemical hardeners.
4. Reduced acid requirements.
5. Less grinding time in preparing finished rolls.
6. Cleaner tanks. Tanks cleaned only half as often.

WRITE FOR INFORMATION on how you can obtain a test quantity to supply one tank. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 58130

Rotogravure roll being copper-plated at the *St. Louis Post-Dispatch*.

ANACONDA®

"PLUS-4"® ANODES Phosphorized Copper

MADE BY THE AMERICAN BRASS COMPANY

to-surface speed, which depends on the plating solution being used, is achieved very easily. The range of speeds has been selected to handle well over 90 per cent of the work normally plated by the method.

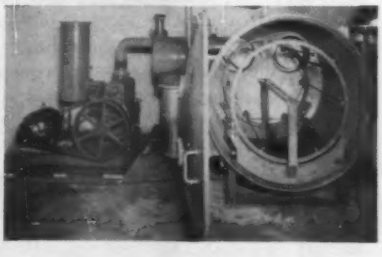
Overloading the turning head is almost impossible, because the only restraining force on the shaft is the friction between the cotton-wrapped stylus anode and the workpiece. However, to guard the speed reducer in case the chuck is rotated by hand for positioning, automatic torque overload protection is also included.

Cost of the entire assembled unit, including motor, Zero-Max infinitely variable speed control, Tork-O-Stat overload protection, two pillow blocks, and 3-jaw chuck is $425, FOB New York.

Vacuum Metalizing Unit

Vacuum Specialists Co., Inc., Dept. MF, Somerville, Mass.

Extremely rapid pumping cycles, in the order of a minute and a half, are possible with this production coating unit, due to the novel 16" high vacuum valves. The entire volume and surface area of the valves are never exposed to the atmosphere. This results in no pumping or outgassing time for this substantial volume and area. It also provides a large high vacuum ballast volume.



This valve design also permits cleaning the interior of the unit through a handhole with a caustic spray. Caustic fumes are vented outdoors. This eliminates the customary troublesome and dangerous handwash with caustic.

The vacuum cycle is semi-automatically controlled by a single rotary selector switch operating fail-safe pneumatic vacuum valves. This reduces the possibility of operator error in valve sequence with the resulting spoiled loads. It is practically impossible to mis-operate the unit.

Stainless Steel Shielded Gloves

Surety Rubber Co., Dept. MF, Carrollton, Ohio.

Produced with a soft comfortable cotton flannel base, a four ply stainless steel mesh is firmly sewn to this new glove, providing easy flexing with maximum protection against sharp or abrasive objects.

Meshields may be worn as produced or can be used as a liner glove under any other type work glove, old or new. The gloves are available in gauntlet style with full coverage or breathing backs with palm and finger coverage only.

Portable Compressor

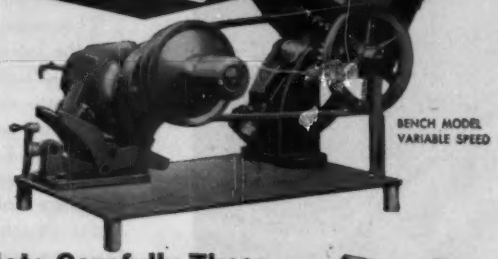
Eclipse Air Brush Co., Dept. MF, 390 Park Ave., Newark 7, N. J.

A new smaller ¾ H. P. top quality electric portable compressor, Model

INVESTIGATE THIS TIME-SAVING

VARIABLE SPEED MODEL

Bench-Type Single Speed



BENCH MODEL VARIABLE SPEED

No. 5—Single Speed

Note Carefully These IMPORTANT POINTS

Barrels can be filled with parts or abrasive—*while running.*

Work can be watched — samples removed for inspection — *while running.*

Angle can be changed for best abrasive or polishing action — *while running.*

Barrels can be emptied by tilting to pouring position — *while running.*

Barrels are made in various sizes, shapes, and materials. They are easily replaced.

No. 5—Variable Speed

No. 5A—Single Speed

No. 5A—Variable Speed

No. 6—Single Speed

If You're a Tumbler, Send for This NEW CATALOG

No. 6—Variable Speed

THE HENDERSON BROS. COMPANY

"The Tumbling Barrel People"

136 SOUTH LEONARD STREET
WATERBURY, CONNECTICUT

SINCE 1910 DESIGNERS AND BUILDERS OF TUMBLING BARREL EQUIPMENT

555, carries all of the important features of its predecessor, the 505, but is much more compact and considerably less expensive. It was designed to give maximum performance and commercial results with low pressure spray painting equipment, the manufacturer states. It is said to be sturdy, trouble-free, and well tested. It is direct driven so there is no hazardous flywheel or belt to wear out. The integral automatic unloader is built in the cylinder head so that the compressor works only when needed.

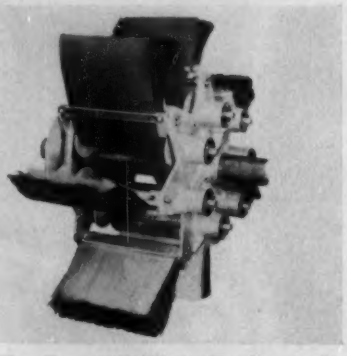
The new compressor delivers over 5 cu. ft. per minute at 45 psi. Other specifications: ¾ h.p. motor, 110 volt, 60 cycle, single phase; direct; or 220 volt. 10" x 2.75" semi-pneumatic tires with ball bearing axle. Spring foot to insure minimum vibration. Removable draw bar. Ample storage tank and pulsation chamber with drain cock. Fifteen feet of heavy duty rubber covered cable. Large intake filter and muffler.

Dimensions are: length, 22"; width, 14"; height, 24".

Abrasive Head

Abrasive Machinery Corp., Dept. MF, 444 So. Pennsylvania St., Indianapolis 25, Ind.

A new coated abrasive head for finishing metals and woods carries a supply of abrasive for replenishing worn material. Designed to use either cloth or paper backed silicon carbide or aluminum oxide abrasive, the material is fed from rolls which are automatically advanced by manual or solenoid activation.



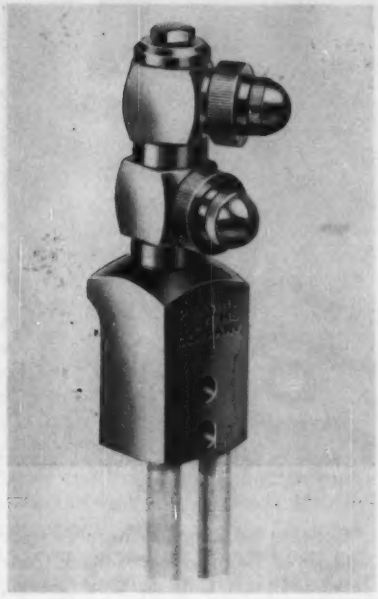
The Smooth-O-Matic Head may be used in portable tools or in permanent mountings. These units are highly adaptable to automatic operations when contours and flat surfaces alike require scratch finishes ranging from satin to coarse finishes, and are particularly adaptable to aluminum finishing in preparation of extruded shapes for anodizing.

Heads are available in abrasive widths of 2" to 50". Recommended motor speed is 750 r.p.m.

Pneumatic Atomizing Nozzle

Spraying Systems Co., Dept. MF, 3245 Randolph St., Belwood, Ill.

A new type pneumatic atomizing nozzle for simultaneous spraying in two or more directions provides a compact, simplified method to meet multiple position spraying needs in a wide variety of industrial applications. The nozzle can be supplied with two, three or four heads, with each adjustable to any position in a 360° range. The overall nozzle unit is extremely compact,



measuring 1¼" x 2" at maximum cross-sections and 4-13/32" in overall height with two swivel heads. Additional swivel heads each add $1\frac{3}{32}$" to the height. Nozzles are supplied standard in brass and are also available in stainless steel.

Alkaline Deruster

Octagon Process, Inc., Dept. MF, 33 Bank St., Staten Island 1, N. Y.

Rustbuster is an alkaline derusting and descaling compound which has solved a number of production bottlenecks in removing deep pitted rust and difficult heat scale. Light oil and grease films remaining after fabricating operations are removed at the same time, leaving a chemically clean surface. The product is also an excellent paint and varnish stripper for the many finishes which are removable by alkali paint strippers.

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CAN BE DELIVERED
SO CONSISTENTLY...
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FLAKE
And you get prompt delivery from ample factory and nearby distributor stocks.
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BUSINESS ITEMS

Free Course in Electroplating

The course of study in electroplating given at the Fort Greene Evening High School, 29 Fort Greene Place, Brooklyn, N. Y. (formerly Brooklyn Evening Technical High School) will begin its Fall term on September 10, 1958.

The session is divided into classroom discussion and laboratory experiments. The classroom topics will include simple calculations, reading graphs, chemistry of the plating tank, pH, wetting agents, pitting, deionizing. The laboratory experiments will include solution analysis, Hull cell studies, anodizing.

Registration begins September 8, 1958, and daily thereafter from 7:00 to 9:00 p.m. Classes will meet on Tuesday and Thursday from 6:45 to 8:15 p.m. including about 6 Fridays. The term begins September 10 and ends January 31, 1959. Register with *Mr. L. Serota* in Room BW17 and 3E2.

Diamond Alkali Co. Appoints DePhillips

Appointment of *Anthony DePhillips* as assistant branch manager of the Philadelphia branch sales office has been announced by *Diamond Alkali Co.*, Cleveland, Ohio. Mr. DePhillips, who has already assumed his new responsibilities, succeeds the late *George J. Soren.*

A member of the company's Philadelphia sales staff covering the Baltimore, Maryland area since 1937, Mr. DePhillips has been associated with the firm in a sales capacity for nearly 30 years, and was a sales representative in New York until 1937.

From May 1 to October 1, 1952, when he was "on loan" to the Federal Government, Mr. DePhillips served in the Chemical, Rubber and Forest Prod-

DAVIS-K GOLD PLATING SOLUTIONS

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Antique Gold Solution

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French Grey Solution

A Rich French Grey that Improves Quality and Costs Less!

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ALL DAVIS-K GOLD PLATING SOLUTIONS ARE:

- **Made in all colors**
- **Color constant**
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- **Bottled by Troy Weight**
- **Made from assayed US Treasury Gold only**
- **Ready for immediate use**

We are fully equipped to reclaim old gold and rhodium solutions. No charge for small sample plating. Write Dept. MF for details.

FREE Consultive Service Call on Davis-K process engineers for help with your special plating problems and installations.

"Where Glittering Elegance Reflects Lasting Quality."

100% PURE GOLD SOLUTIONS DKP

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135 West 29th St. New York 1, N.Y.

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ucts Bureau of the National Production Authority.

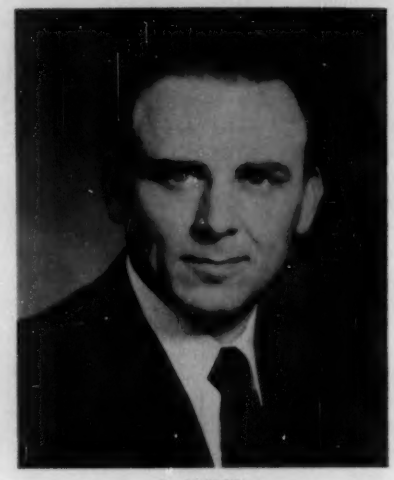
President of the Baltimore Chapter of the Armed Forces Chemical Association, he is also affiliated with the National Executives Reserves, Department of Commerce; Baltimore Chemists Club, and Theta Nu Epsilon.

Mr. DePhillips, a native of Munnsville, N. Y., earned his B.C.S. degree in economics from New York University in 1932.

Alsop Appoints New Northeast Sales Engineer

Arvid Willen has been appointed by the *Alsop Engineering Corp.* to its sales engineering staff, and will operate direct from the main office in Milldale, Conn. He will serve the territory covering Connecticut, New York State above Westchester County, Western Massachusetts, and part of Vermont, most of which was formerly covered by the O. E. Pfannkuch & Co. of Bridgeport, Conn.

Mr. Willen was previously employed as a district sales manager of Master Electric Co., Division of Reliance Electric and Engineering Co. of Dayton, Ohio. He has had broad experience as an application engineer with extensive background in sales and advertising. He did work in research and development for Chief of Naval Operations in Washington and Naval Ordnance Laboratory in Maryland.



Arvid Willen

Colleges he attended were Newark College of Engineering, Newark, New Jersey; Upsala College, East Orange, New Jersey; Brown University Providence, Rhode Island, Georgetown University.

DeLuca and Henriksen Elected by Acoustica

Frank P. DeLuca, Jr. has been elected a vice-president of *Acoustica Associates, Inc.*, Mineola, N. Y. and Culver City, Calif. He will be responsible for the operation of the firm's newly-opened facilities on the West Coast.

Prior to his association with Acoustica, Mr. DeLuca was associated with the Hughes Tool Co. and the G-M Development Co., both in Southern California.

The election of *Gerald M. Hendriksen* as a director and vice president was also announced. He was formerly director of research and engineering for the Turbo Division of American Machine and Foundry Co. in Pacoima, Calif. In his new position, Mr. Hendriksen will direct the engineering and research activities of the company in both its military and commercial business.

Central Solvents & Chemicals Co. Establishes Two Scholarships

Two new scholarships have been established at Illinois Institute of Technology, Chicago, by *Central Solvents and Chemicals Co.*

Called the *William J. Hough* Scholarships in honor of the company's founder, the scholarships will provide $400 a year for each of two students with either junior or senior standing in chemical engineering.

Students who intend to work in the

paint, adhesive, chemical, or metal fabricating industries in the Midwest will have preference for the annual scholarships.

Final selection of the recipients will be made by the Illinois Tech. scholarship committee.

Coated Abrasive Machine Show Attracts Thousands

The growing importance of coated abrasives as a basic industrial tool was emphasized at the *Behr-Manning Company*, June 9-13, when 150 new abrasive machines were viewed and tested by several thousand industrial production men from all parts of the United States and half a dozen foreign countries. The week-long show was officially opened with a press preview for industrial editors and a ribbon-cutting ceremony performed by New York's Governor *W. Averell Harriman.*

This 3rd National Coated Abrasive Machinery Show, sponsored by the Behr-Manning Co., a division of the Norton Company, was held in its new $1,000,000 Product Engineering building at Troy, N. Y. The abrasive manufacturer acted as host to the machinery industry, inviting machine manufacturers to demonstrate developments of the past two years.

Castle Appointed Technical Director of Abrado Finish Corp.

Appointment of *C. Heamon Castle* as technical director has been announced by *Abrado Finish Corp.*, Grand Rapids, Mich.

Mr. Castle holds a degree in metallurgical engineering from Michigan College of Mines and Technology where he graduated in 1933. He formerly was technical director and vice-president of Roto-Finish of Kalamazoo, Mich., where he worked for 14 years. He has spent the past 25 years primarily in the barrel finishing field, holding several patents on methods and processes for barrel finishing.

C. Heamon Castle

Mr. Castle's primary responsibility will be the development of new and better barrel-finishing methods and materials in the newly completed laboratories of the company.

Recent Appointments at Binks Manufacturing

Earl P. Sullivan, Wallace W. Denhoff and *George Knetl* have been promoted to new posts at the *Binks Mfg. Co.*

Mr. Sullivan has been appointed district manager of the Chicago sales territory and, in addition to supervising field representatives in the area, he will be responsible for a program of maintaining and expanding a strong jobber organization. Before his appointment, Mr. Sullivan had served for nearly 20 years as a sales engineer for the company.

Mr. Denhoff has been named to the post of assistant district manager under Mr. Sullivan. He has been a Chicago sales engineer for the past five years.

Mr. Knetl, who has been with the firm for 15 years, has been named as-

MODERN BARREL FINISHING
methods and machines can
IMPROVE PRODUCTS . . . SPEED WORK . . . CUT COSTS

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NEW "POLIACTION" BARREL FINISHING MACHINES
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BAIRD . . . one of the oldest and largest manufacturers of Barrel Finishing Equipment . . . is your headquarters for practical help on your problems. It always pays to . . .

Write Dept. MF. ***Ask BAIRD About It!***

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Builders of High Production Machinery Since 1846
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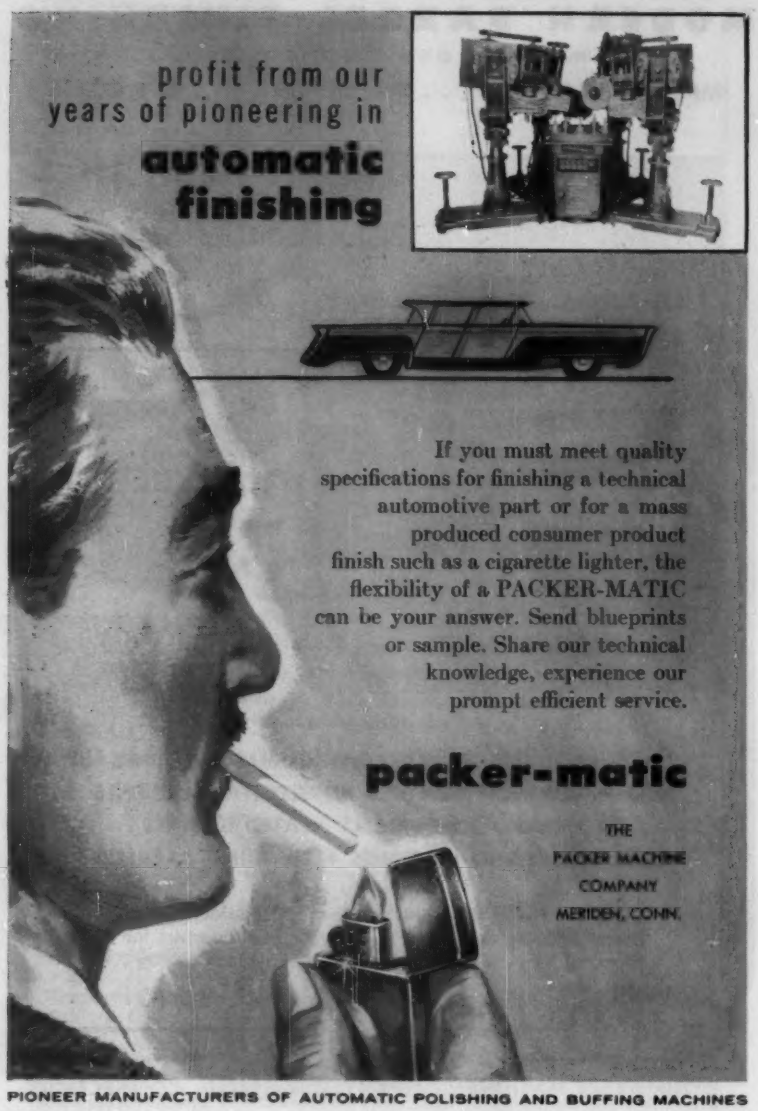
profit from our
years of pioneering in
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If you must meet quality specifications for finishing a technical automotive part or for a mass produced consumer product finish such as a cigarette lighter, the flexibility of a PACKER-MATIC can be your answer. Send blueprints or sample. Share our technical knowledge, experience our prompt efficient service.
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MERIDEN, CONN.
PIONEER MANUFACTURERS OF AUTOMATIC POLISHING AND BUFFING MACHINES

George Knetl

sistant director of engineering and research. He will help coordinate all engineering activities and serve as liaison between his department, sales, production and the executive branches of the company.

Prat-Daniel Appoints Sales Engineers

Thermobloc Division of *Prat-Daniel Corp.*, South Norwalk, Conn., manufacturers of industrial heating equipment, has announced the appointment of two new sales engineers for Ohio.

Operating from their Cincinnati headquarters, the *Chas. F. Childress Co.* will cover the southwest portion of Ohio, the entire state of Kentucky, and a portion of Southeast Indiana. *C. E. O'Brien Co.*, of Dayton, will handle sales in a 17-county area in South Central, Ohio.

Trade Sales Representatives Added by Adelphi Paint & Color

Adelphi Paint & Color Works, Inc. has announced the appointment of two additional sales representatives for that company.

William Goldthwait will function in one of the New England territories. *Cliff Brunton* will function as a trade sales representative in a major portion of the state of Michigan. Both have successful sales backgrounds in the paint and paint sundry fields.

Bradley Dewey Forms New Chemical Company

Announcement has been made of the formation of the *Hampshire Chemical Corp.*, to research, produce and market

Earl P. Sullivan

Wallace W. Denhoff

Dr. John J. Singer

a new group of chemical specialties, including nickel and copper stripping compounds. The corporation's new plant occupies a twenty-acre rail site along the Merrimac River on Route 3 in the southern outskirts of Nashua, N. H.

Dr. John J. Singer, of Westboro, Mass. is president. *Mark Weisberg* of Providence, R. I. is vice president in charge of research. *Alfred A. Lawrence* of Winchester, Mass. is vice president in charge of sales. All are well known in the chemical industry. Together with *Bradley Dewey*, board chairman, they bring a wealth of administrative, research, production, application and marketing experience to the company.

Bradley Dewey was founder of Dewey & Almy Chem. Co. and, shortly after retiring at the age of sixty-five, founded Bradley Container Corp. which was sold two years ago to American Can Co. He holds several honorary degrees, has been president of the American Chemical Society.

Dr. Singer, in his middle thirties, was formerly president of the United Chemical Corp. of New England in Providence, R. I. He has also been associated with Versenes, Inc., and the Bersworth Chem. Co.

Mark Weisberg founded the Alrose Chem. Co. (now a Geigy subsidiary), along with several other extremely successful chemical operations. He has been head of his own research and consulting laboratory in Providence, and was previously active in United Chemical with Dr. Singer.

Alfred A. Lawrence was connected with Dow Chem. Co. in sales capacities for about 18 years. For years he has

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TYPE "U"
PATENT PENDING
World's first successful U-tube **ACID** Heater—Guaranteed to outperform and outlast all other quartz heaters.

TYPE "GN"
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Standard straight tube Quartz **ACID** Heater—Vapor-proof junction box; replaceable heating element.

TYPE "MB"
"Multi-Blade", Metal-sheathed **ALKALI** Heater—Portable, burn-out proof, easy mounting, long life.

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ACCURACY—EFFICIENCY—LONG LIFE—and ECONOMY
...you'll get it with Glo-QUARTZ!
Available from your Electroplating Distributor!

Glo-QUARTZ ELECTRIC HEATER CO., INC.
*Trademark Reg. U.S. Pat. Off. WILLOUGHBY, OHIO Phone: Willoughby 2-5521

Mark Weisberg

Bradley Dewey

been Dow's Boston and New England sales manager.

Heatbath Corp. Appoints Petroff

Heatbath Corp. announces the appointment of *Pete Petroff* as sales representative in Western Ohio, Southern Indiana and Northern Kentucky.

Pete Petroff

Mr. Petroff is a graduate of Ohio State University and was formerly associated with the Bison Corp. of Canton, Ohio. He will handle the firm's complete line of metal finishing and heat treating products and will have headquarters in Columbus, Ohio.

Also announced was the transfer of *Jim Wheeler* to the Chicago district where he will assume new sales duties. Mr. Wheeler will continue to supervise sales in the area covered by Mr. Petroff as well as in the Cleveland area.

Narda Appoints Steen Distributor Sales Manager

Paul W. Steen has been appointed manager of distributor sales for *Narda Ultrasonics Corp.*, Mineola, N. Y.

Mr. Steen is a business administration graduate of New York University, and studied electrical engineering at Adelphi College. His background includes four years in maintenance of communications equipment with the U. S. Army Air Force during World War II. From 1946 to 1949, he taught electronics and commercial broadcasting and was director of the American Radio Institute of Buffalo from 1949 to 1952. He was employed by the Sperry Gyroscope Co. from 1952 to 1956, and was advertising manager of Potter Instrument Co., Inc. prior to joining Narda.

Paul W. Steen

Wright To Head H-VW-M's New Special Products Sales

Hanson-Van Winkle-Munning Co.

NUGLU

THE IDEAL ADHESIVE

For Setting Up or Recoating Polishing Wheels, Abrasive Belts & Discs

Nuglu, a liquid glue, developed to lengthen wheel life — produce a better finish, and increase metal finishing production.

BRUSHING NUGLU

A mixture of Nuglu and graded aluminum oxide grain —

Save on operating costs, increase production, reduce wheel inventories, and obtain greater results, with less costly materials, in fine polishing work!

Ask for information on The Siefen Finishing Systems

— Also for better metal finishing use Siefen Compositions • Stainless Steel • Bar (Grease) in Tube • Liquid Tripoli • Liquid Grease • Lapping Compound • Burring Compound.

Siefen For Service

J. J. SIEFEN CO.

5643 LAUDERDALE, DETROIT, MICH.

1927 Our Thirtieth Anniversary 1957

Why *Stortswelding* makes this a

better electro-alkali cleaning tank

Part of the answer, a big part, is that all welding at Storts is done to a single standard of high quality — every weld develops the full mechanical properties of the plate material, or better. Storts standard double welding makes all seams leakproof. The rest is that the experience of fabricating many thousands of tanks to order for plating service results in a know-how which extends to every last small detail. Add high standards of precision, for assurance that your completely fitted tanks fit into place and are ready for work on arrival. Get our estimates on single tanks or complete tank cycles.

STORTS WELDING COMPANY INCORPORATED

38 Stone Street
MERIDEN, CONN.

Manufacturers of Welded Fabrications to Specification

Howard L. Wright

has announced the appointment of *Howard L. Wright* as manager of their new special products sales. Establishment of the new sales section under Wright's direction is intended to develop new markets for the company, especially in the field of electrical and mechanical products.

Wright has been with the company for 11 years, serving as district manager for the company in the Middle Atlantic States area. A graduate of Franklin & Marshall College, he served in the U. S. Navy during World War II.

Allied Research & Wagner Brothers Merge Operations

Allied Research Products, Inc., of Baltimore and *Wagner Brothers, Inc.*, of Detroit have merged their operations, a move accomplished by Allied's acquiring Wagner's metal finishing operational assets and products. Included in the transaction was the sale of some of Allied's common stock to Wagner Brothers, Inc., which is now divorced from the metal finishing field but will continue to operate its subsidiary, Automatic Molding Machine Co., Inc.

Through the merged operations, Allied Research now offers the metalworking industry a complete line of chemical and electrochemical processes, anodes, rectifiers, automatic equipment and supplies for metal finishing. In addition, research and development facilities are increased and the field sales and service organization strengthened. In jointly announcing the merged operations, *H. C. Irvin*, president of Allied Research, and *J. R. Wagner*, president of Wagner Brothers, Inc., and now administrative assistant to Mr. Irvin,

Harry Irvin, at right, President of Allied Research Products, Incorporated, welcomes Joe Wagner into the Allied organization, and at the same time congratulates him on becoming Administrative Assistant to the President.

TAKE THE **LOAD** OFF YOUR **TOP BRASS**

USE **TRUE BRITE BRASS SOLUTIONS**

Trouble Free — Low Cost
Little Supervision Needed
Ready To Use — Just Add Water
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PPI Tanks are made of chemically resistant Fiberglas sheets . . . Joined together with a special Fiberglas resin. They can be used successfully for chromic acid bright dips, acid pickles, rinses after acids and certain plating solutions.

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PPI — Tanks are built to your needs and specifications. Send us dimensions and any other particulars such as overflow dams, nipples, etc., and we will be happy to quote prices.

Dependable PPI Products . . .

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1509 N. WASHINGTON
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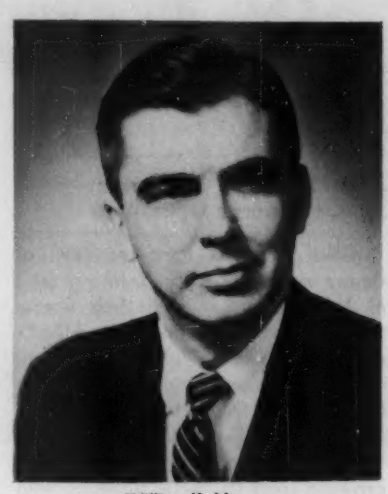
emphasized that the key personnel of both companies will continue in the same general functions to assure uninterrupted and improved service on all products.

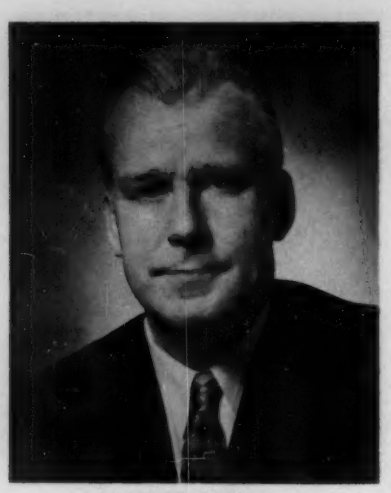
Allied's headquarters operations are in Baltimore at 4004 East Monument St. while branch administrative offices have been established at 400 Midland Ave., Detroit. Other facilities provided by the combine include manufacturing in one plant in Baltimore and three in Detroit with research and pilot plant facilities in both cities. Sales representatives and distributors cover the nation and Canada with district sales headquarters being located in Baltimore, Chicago, Detroit and Bridgeport, Connecticut. Warehouses are located in leading industrial centers from coast to coast. The company also has licensees on the West Coast and in Europe and exports direct to other countries not yet covered by license arrangements.

Enthone Promotions and Appointments

William K. Murray has been promoted to manager of customer service by *Enthone, Inc.* of New Haven, Conn., a subsidiary of *American Smelting and Refining Co.*



William K. Murray



Edward B. Washburn

Mr. Murray joined the firm in 1953 as technical service engineer and became supervisor of the technical service laboratory in 1954. He is a graduate of Rensselaer Polytechnic Institute and was associated with Wallace Silversmiths in Wallingford, Conn., prior to coming with Enthone. He is a past president of the New Haven Branch of the A.E.S. and a member of the American Society for Metals. In his new capacity, Mr. Murray will have charge of sales promotion, publicity and technical service.

Edward B. Washburn recently joined

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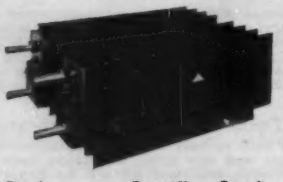
A BETTER SOURCE OF DC POWER — MORE FOR YOUR MONEY

★ Operates from —40° to 225° F.
★ 50 to 50,000 Amperes DC
★ Built-in Voltage Regulator and Meters
★ Heavy Duty Transformers, Husky Fans

Two styles available—1. Selenium for cool zones, or 2. Magnesium copper sulphide for the hot, dirty jobs. Units still running after 4 years of constant duty.



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Magnesium copper sulphide rectifiers make your plating power supply more rugged and dependable. Magnesium radiator fins for fast heat dissipation and lighter weight. Matching pairs.

Model 4045—750 amps. at 12 volts DC—1500 amps. at 6 volts D.C. Operates on 208, 220 or 440 A.C. Weight 525 lbs. F.O.B. Indianapolis, Indiana.

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. . . determines sulfate content in a chromium plating bath . . . directions are easy to follow . . . no calculations necessary . . . readings are directly in ounces per gallon. Write for descriptive literature.

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Carl Schaefer

William R. Schmidtke

the company to succeed Mr. Murray as supervisor of the technical service laboratory. In this capacity he will direct the staff of service engineers and chemists in the solution of customers' metal finishing problems. Mr. Washburn brings a wealth of experience to his new position. He is a graduate of Brown University where he majored in chemistry. For many years he was supervisor of finishing operations and plant chemist at McKinney Mfg. Co., Pittsburgh, Penna. Most recently, he was superintendent of finishing at Waterbury Mfg. Div., Chase Brass & Copper Co., Waterbury, Conn. In the A.E.S., Mr. Washburn is a past-president of the Pittsburgh Branch and was a 2nd vice-president of the Newark Branch. He is presently a member of the Waterbury Branch where he is serving on the By-Laws Committee.

Carl Schaefer has joined the firm as production manager and purchasing agent. He has had over twenty years of experience in the metal finishing industry. Prior to joining Enthone he was manager of metal finishing at Casco Products Corp., Bridgeport, Conn. He is a graduate of the University of Michigan and a member of the Electrochemical Society, Society of Plastics Engineers and ASTM. He is a past president of the Bridgeport Branch of the A.E.S.

William R. Schmidtke has been appointed assistant office manager and safety director. He comes to the company from the New York office of ASARCO.

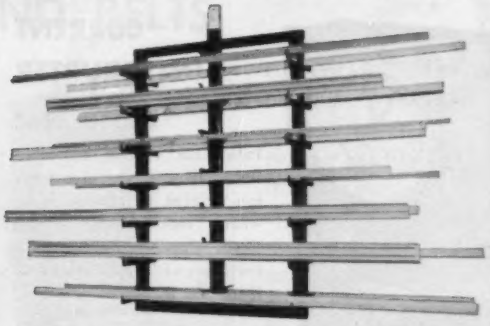
Engelberg Huller Changes Name

Engelberg Huller Co., Inc., announces that the company name has now been changed to *Engelberg, Inc.*,

NOW – from Davies

ANODIZING RACKS – Titanium Tipped

for FEWER REPAIRS • LONGER LIFE • LESS COST



OVER 3000 STANDARD DESIGNS
or CUSTOM DESIGNED FOR ANY APPLICATION

With highly acid-resistant titanium tips, Davies plastisol coated anodizing racks require only about 1/7 the number of repair jobs needed by all-aluminum racks. One customer, in three months time, saved nine times the additional cost of the titanium tips.

For dependable and economical anodizing racks and ENGINEERED racks for all types of plating, order today from Davies — largest rack manufacturer west of the Mississippi.

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Epoxy Filter Chamber
DEFIES
Chemical Attack
& Heat!
...up to 220° F

dynel filter tubes, stainless steel center rod, self-priming SS 316 pump

trouble-free DEPTH FILTRATION for problem solutions

Sethco
FILTER PUMP UNITS

MODEL ASIN-400

No more difficult hard-to-handle solutions. Hot, highly concentrated acids or alkalies filter fast and clear through these specially designed Sethco Filters. Non-porous, heavy duty construction and automatic reversal for self-washing. Portable, low cost operation.

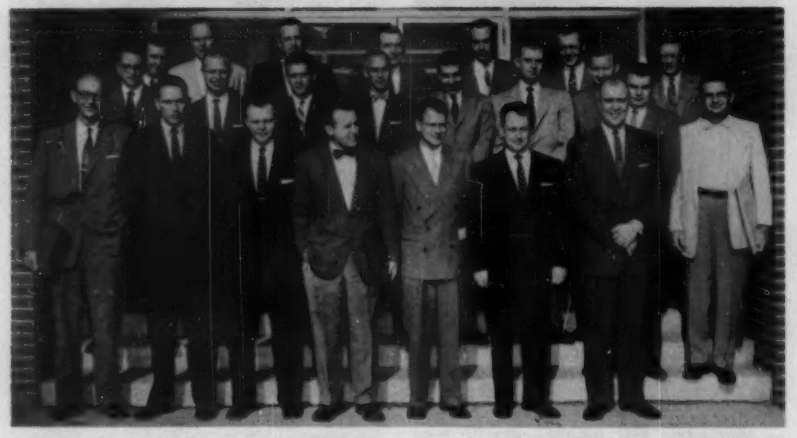
Over 25 other models— 50 to 3000 gals./hr.

Write for illustrated Fact Folder

SETHCO MFG. CO., 2286 Babylon Turnpike, Merrick, N. Y.

due to the tremendous growth of the firm's abrasive belt grinder division which, in 1957, accounted for about 80% of total sales.

DOW HOLDS SOLVENTS CONFERENCE



Dow solvents field salesmen attended a solvents conference, April 21-25, in Midland, to discuss new product developments. Front row, left to right: Don Huff, San Francisco Sales; D. G. Arteberry, St. Louis Sales; W. J. Keenan, Midland Sales; J. D. Themins, Detroit Sales; W. H. Colgrove, Chicago Sales; D. L. McEwen, Boston Sales; second row: A. J. Pastor, Technical Service and Development T. J. Christiansen, Industrial Solvents Supervisor; G. G. Taddei, Chemicals Merchandising; J. A. Skaggs, Texas Production; J. A. Masmanian, New York Sales; C. J. Giles, Cleveland Sales; R. J. Clark, San Francisco Sales; A. E. Schober, Technical Service and Development; L. S. McDonald, Texas Production; back row: C. C. Castle, Drycleaning Supervisor; D. H. MacDonald, Midland Technical Sales; J. D. Kerr, Technical Service and Development; F. W. Larabee, Solvents Section Manager; J. W. Woods, Los Angeles Sales; W. U. Seiler, Field Service Supervisor; and J. L. Sherk, Chemicals Merchandising Manager.

Eugene L. Sommers Elected President of Sommers Bros. Mfg. Co.

Sommers Bros. Mfg. Co., 3443 North Broadway, St. Louis, Mo., at a recent stockholders meeting, elected *Eugene L. Sommers* as president to carry on in the position formerly held by his uncle *Carl J. Sommers*, who passed away on May 5th, 1958.

Worthy Products in New Location

Worthy Products Co., manufacturers of paint strainers, have moved to the Reading, Pa., area. Their new address is Box 123, Temple, Pa.

DuPont Opens New Laboratory

Opening of a new $5 million laboratory to provide service to customers and for evaluation of new or improved products of the *Du Pont Company's* electrochemicals and pigments departments was announced by the company on May 21. Although some facilities are shared jointly by the two depart-

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THE *NEW*
MACARR
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MODEL CIAC

Interrupts voltage to main line starter of rectifier feeding current to plating tank, where interruption is desired. Capable of handling rectifiers with capacity ranges from 500 to 10,000 amps.

TYPE CIDC

Interrupts current using auxiliary DC switch of proper capacity for interruption at bus-bars. Models available from 250 to 1500 amps. DC:

MODEL CIDC-250
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MODEL CIDC-1000
MODEL CIDC-1500

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ments, the building houses separate laboratories for product development in the paint, metals, textile, plastics, paper, ink, and allied chemical fields.

The laboratory contains 81,000 square feet of floor space, including 150 separate rooms, laboratories, and demonstration areas. The technically trained staff of 130 includes chemists, chemical engineers, metallurgists, and other specialists.

The electrochemicals wing, on one floor, contains equipment for duplicating customer operations in the sodium, peroxygen, chlorine, vinyl, and related product fields.

The pigments laboratory occupies two floors and has facilities for developing tailor-made pigments for the paint, plastics, rubber, paper, ink, and other industries. In addition, there are complete technical service facilities for titanium, silicon, and niobium, also made by the Pigments Department.

A 75-foot-long degreaser, only one of its kind, incorporates major features of various types of commercial vapor degreasing machinery, testing performance of trichlorethylene in metal cleaning. Electroplating, descaling, and steel heat-treating equipment provide facilities for evaluating end uses for sodium products, including a new high speed copper plating process announced recently.

KELITE HOLD CONFERENCE

Kelite sales personnel who attended a recent Key Club meetitng and sales management conference at Ponte Vedra Beach, Fla. (First Row) W. E. Wilgan, G. T. Henry, C. A. Scheller, W. Middough, C. N. Shalfant, L. J. Gauthier, F. W. Weldon, J. E. O'Brien, W. J. Boyd. (Second Row) P. J. Stroh, R. J. Racine, Laboratory Director Dr. S. Spring, Marketing Director Wm. Sorensen, President L. C. Sorensen, Technicolor Director L. McDonald, V. E. Bowes, L. W. Cunningham. (Third Row—standing) C. F. Appleby, H. W. Kole, J. S. Vanos, A. Damalak, J. G. Schirtzinger, R. G. Hazel, E. Miller, P. L. Pearson, F. M. Roberts, W. T. Cullen, H. H. Cunningham, B. H. Waters, W. Hocker, G. S. Johnson, L. W. Whitman, K. C. Edson, C. R. Clime, A. N. Robertson, A. N. Snyder Jr., J. McLaughlin. Missing: N. E. Bartholomew, A. E. Sakavich.

BONDING CEMENT FOR ABRASIVE WHEELS AND BELTS

GRIPMASTER® Bonding Cement requires no special sizing thereby cutting heading up time to a minimum. Actually one step in the heading up process can be eliminated. GRIPMASTER also insures a superior bond and greater wheel flexibility. This is what people have been looking for in a bonding cement. Send today for a free test sample of GRIPMASTER and how-to-use literature.

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A metal fabricator writes* – "We estimate savings of 24% in finishing costs."

*Name on application.

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AGATEEN
THE LAST WORD IN QUALITY

Commercial Filters Corporation Acquires Industrial Filtration Company

Commercial Filters Corp., a subsidiary of *Ogden Corp.*, has acquired the *Industrial Filtration Co.*, manufacturers of Delpark filters.

Delpark will operate as a part of Indiana Commercial Filters Corp., with headquarters in Lebanon, Ind.

Reynolds Metals Co. Moves Sales Headquarters to Virginia

The sales headquarters of *Reynolds Metals Co.* has moved from Louisville, Ky., to Richmond, Va. All of the company's headquarters functions — including manufacturing, marketing, advertising, research and corporate groups — are now located in Richmond.

Headed by *David P. Reynolds*, executive vice-president for sales, over 400 sales employees were involved in the mass transfer. Unaffected by the move are seven aluminum fabricating plants in Louisville.

NEW BOOKS

Water and Waste Control for the Plating Shop

By Joseph B. Kushner. Published by Joseph B. Kushner Electroplating School, 115 Broad St., Stroudsburg, Pa. Price: $7.50. 99 pages.

This mimeographed material was originally prepared as a home study course in the subject and deals with water in the plating room and resulting wastes, from both the theoretical and practical aspects. Covered in complete detail are the efficient use of water, contamination of plating baths, rinsing and dragout, and waste treatment and recovery. Six appendices provide for calculating rates, design data, and an economic analysis, plus a list of suppliers, and references for further investigation.

Although other books have been written on the broad subject of industrial wastes, this volume concerns itself only with metal finishing and, as a result, presents more detailed information than will be found in any other publication.

Synthetic Detergents and Emulsifiers

By John W. McCutcheon. Published by John W. McCutcheon, Inc., 475 Fifth Ave., New York 17, N. Y. 1958. Price: $2.50. 78 pages.

This is a bound reprint of an article appearing in the December 1957 - January, February, March and April 1958, issues of *Soap and Sanitary Chemicals* magazine. The first two pages of the reprint are devoted to a general summary of the synthetic detergent field and its most recent developments. This is followed by seventy-five pages of tables which list alphabetically over 2000 U. S. trade name products together with manufacturer, class and formula, main use, form, per cent concentration, type and further remarks. About 250 manufacturers whose products are given, are listed in the appendix.

Film Formation, Film Properties, and Film Deterioration

Technical Editor, Charles R. Bragdon, Published by Interscience Publishers, Inc., 250 Fifth Ave., N. Y. 1, N. Y., 1958; 422 pages. Price $9.75.

This book represents an excellent guide for the organic coating manufacturer and user whose vital concern is the production and application of higher quality finishes. The information, which is of a basic nature, contained in the book results from a careful study made by the Research Committee of the Federation of Paint and Varnish Production Clubs over a ten-year period. The book consists of sixteen chapters, a foreword (by M. A. Glaser, President of the Federation), an editor's preface, and an index. A chapter on outdoor exposure tests provides an interesting summary of exposure tests, with tables showing the progress of paint film deterioration along with photographs of the exposed panels.

Film Formation, Film Properties, and Film Deterioration is a laudable example of the flourishing spirit of cooperation currently existing in the organic coatings field. Though only three decades ago paint formulas and properties were jealously guarded secrets by manufacturers, it is fortunate that, today the majority of progressive organic coatings concerns show an active interest for improving their products by exchange of ideas. The book is living proof of this spirit and should provide a favorable impetus for future texts on the subject.

Metals Engineering—Processes

Edited by Roger W. Bolz. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. 1958. Price: $13.50. 423 pages plus index.

Sponsored by the Metals Engineering Handbook Board of the *American Society of Mechanical Engineers*, this is the fourth and final part of the ASME Handbook, and covers the various processes by which metals are converted into finished products. Included in the 45 sections are data on casting, heat treating, welding, machining, finishing and electroforming, among others. For each method basic physical characteristics and general advantages and limitations are detailed.

Illustrated with hundreds of charts, illustrations, and other aids, the book is not devised for the specialist, who will consider the material presented in his specialty far from complete. However, for the technical man who has occasion to concern himself with the ancillary operations involved in the production of a product from metals and alloys, the information will be very helpful toward broadening his background of knowledge so that he can obtain an intelligent correlation between the process in which he qualifies as an expert and both the preceding and subsequent operations.

News from California

By Fred A. Herr

Golden Latshaw, formerly president of Hydromatic Metal Finishing Corp., of Cleveland, O., and a finishing consultant in Southern California, has joined C. O. Fielder, Inc., 2221 E. 37th St., Los Angeles, as sales and technical director of the company's new Surface Systems Division.

The division was created recently to serve the western metal finishing industry with a complete barrel finishing service, including equipment manu-

facture, finishing service, stocking of compounds and media, a processing laboratory, and engineering and consulting service.

The firm was founded in 1942 by *C. O. Fiedler* as a proprietorship and incorporated this year. Primary products heretofore have been machinery and equipment for the paint, food, ceramic, and mining industries.

Precision Engineering Co. of Sacramento, Calif., rebuilders of engine crankshafts, have completed installation of equipment for shotpeening crankshafts prior to hard chromium plating. This operation, it is reported, drastically increases the fatigue strength of the rebuilt shaft.

Negotiations are reported to have been completed under which the Dow Chemical Co. of Midland, Mich., has acquired the common stock of Extruders, Inc., Hawthorne, Calif., suppliers of polyethylene film to the west coast market.

By the terms of the transaction, Extruders, Inc., has become a Dow subsidiary, but continues to operate under the same management, which includes *William B. Sander* as president, and *John A. Croft* as secretary.

Robert Strich has been named chief engineer of the Los Angeles division of Cannon Electric Co., designers, producers and finishers of electrical panels and other equipment. Strich joined the firm as a product engineer in 1953 and, for the past 2½ years, has been supervisor of the product engineering department. He had previously served with Cannon Electric, Ltd., London, the company's British affiliate.

Simultaneous with announcement of opening of a Los Angeles district sales office at 1901 W. Eighth St., the Selas Corp. of America of Dresher, Pa., reports the appointment of *Raymond J. Kenard, Jr.*, and *Stuart A. Whitehurst* as sales representatives to cover the California, Arizona, Nevada and Utah territory. Whitehurst will direct his attention largely to the metals, ceramics, glass, paint and allied industries; and Kenard to the petroleum, petrochemical and chemical industries.

The Behr-Manning Co. of Troy, N. Y., manufacturers of coated abrasives, pressure-sensitive tapes and sharpening stones, has appointed *Wilford B. Tyler* as manager of its Los Angeles branch, succeeding *R. H. Asman*, who has resigned. Tyler had been assistant branch manager at Los Angeles for the past 2½ years.

The container division of Rheem Manufacturing Co., South Gate, Calif., is reported to be employing with success a new coating process for lining steel drums which is said to give the drums a longer life.

The drums are centrifugally lined in conjunction with a curing process in which the drums, after the coating material has been applied, are conveyorized through an oven in a vertical position with each drum shell serving as an auxiliary flue and introducing a continuous flow of heated air across the lining. The centrifugal spray pro-

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key to GREATER BUFFING OUTPUT

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cess involves use of a dynamically balanced edge-perforated disk which spins at 3600 rpm. and casts off a uniform coating of atomized material. The centrifugal spray process, it is reported, permits use of lining material of low solvent content, which decreases evaporation, particularly pinholing and blistering during the curing in the oven.

Electroforms, Inc., 1841 West Gage Ave., Los Angeles, in May was nearing completion on the construction of a new 20,000 square foot plant at 239 E. 165th St., Gardena, Calif., which reportedly will represent the largest plant in the United States devoted exclusively to production of metal parts by electroforming.

The firm has developed techniques that simplify and make more adaptable such items as aircraft ducting, missile plumbing, aircraft fuel line sections, missile nose cones, wind tunnel nozzles, jet engine parts and other complicated configurations. The new plant will have facilities for producing parts by electroforming substantially larger than the maximum of 9 x 8 feet possible with present equipment.

Mefford Chemical Co., Los Angeles, has reported the appointment of *Gary Stukkie* to the company's sales engineering staff. Stukkie was formerly active in a sales capacity with Merchants Chemical Co., Chicago.

Percy A. Haythorne has been elevated from the post of chief engineer to manager of development and process engineering for Rheem Mfg. Co.'s Aircraft Division at Downey, Calif. He formerly served as chief metallurgist for Douglas Aircraft Co. at Tulsa, Okla.; director of metallurgical research for Lockheed Aircraft, Burbank, Calif.; and as metallurgical engineer for the Youngstown Sheet & Tube Co., East Chicago, Ill.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Indianapolis Branch

The April 2nd meeting was held at Fox's Steak House with thirty-two attending. After the usual introduction *Addison Howard* presented *Dr. D. A. Swalheim* of duPont who, with color slides, talked about the latest developments in cyanide copper plating. Several questions were asked and answered very satisfactorily.

Minutes of the March meeting were read and accepted. The treasurer's report was also accepted as read in a motion by *Marshall Whitehurst.*

Application for membership for *Norris M. Archer* was received and accepted by acclamation. *John Holland* read the financial report of the January Interim meeting indicating a cost slightly less than was anticipated.

The secretary, reporting on a board of managers' meeting on March 24th, presented on the blackboard the initial slate of candidates for office the following year. Also, *Bob Bruck* has consented to serve as Tri-State custodian of funds since *Edna Rohrabaugh* resigned due to new work and duties.

Leo Reynolds, reporting on the Tri-State meeting of delegates, said that the Indianapolis Branch must elect a junior delegate by March 1959. He also requested help from suppliers, if necessary, to make a success in the '59 Tri-State meeting.

A request was made for questions to promote the educational sessions which the committee can use at the Cincinnati Convention. *John Hood* made a motion that the Indianapolis Branch contribute $100 to the National A.E.S. Research Fund. This motion was seconded and carried.

New members elected were *Norris M. Archer, Edward F. Donlan* and *James A. Wheatley.*

Paul Freeman
Secretary

Toronto Branch

The "Gone Fishing" sign was hung on the door Friday, May 9th, (See you all in September). 30 members were present for dinner, the past presidents were guests of the branch. *Colin Turner, Jim Vaughan* and *Ben Cameron* were on deck.

Professor *Bert Gerrans*, honorary member, is confined to Western Hospital and we wish him a speedy recovery. The dapper *Cy Short* was missed and we hope the "Ladies in White" will release him real soon, Welesley Hospital is the address.

Four visitors were welcomed and three applications were accepted. *Ben Cameron* presented *Mel Green* with the past president's pin; congratulations for an excellent job on the gavel.

Mr. Hitter and Mr. Faulman, of Imperial Plating Rack Co., London, Ontario, spoke on "Rack Manufacture." *Mickey Faulman* answered all questions.

A. W. Wilson
Librarian

Strip Nickel Faster use STRIPODE

— the proved addition agent —

Users are enthusiastic about STRIPODE. Here's what they say, "Speeds up removal of nickel plate"; "Protects the metal from pitting and roughening"; "Uses less acid"; "Gives marked savings by eliminating sand blasting and severe buffing operations". Try it in your plant.

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for NICKEL PLATING

The one bath especially designed for plating DIRECTLY on ZINC, LEAD, ALUMINUM, BRASS, COPPER and IRON.

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Harder CRACK FREE deposits. Increased throwing power. Less sensitivity to sulfate content. Exceptionally fine results plating anything calling for Decorative or Hard Chrome.

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British Columbia Branch

The meeting of May 15, 1958 was held at the N.F.B. Theatre, and Pres. *Bill Marquardt* mentioned letters received from Int. President, *F. T. Eddy*, *Roy Alexander* and Progressive Mfg. Co. *J. Lee* asked for suggested date for C.P.A. tour of Bristol Britannia Airliner; June 23rd was the date chosen. June 13th is to be the date of next meeting at which *C. K. Sample* of International Nickel will speak.

After nominations closed the election was held, at which the following were elected: Past President, *Bill Marquardt;* President, *Jim Lee;* 1st Vice Pres., *Gordon Smith;* 2nd Vice Pres., *Walter Kellerman;* Secretary, *Nelson Shepperd;* Treasurer, *Ralph Wolloschuk; Directors, Ken Bain, Claus Schlossareck;* Librarian, *Jim Hurford.*

The business meeting adjourned at 9:45 and was followed by the extremely interesting film called "Milling And Smelting The Sudbury Ores" which showed the various smelting and flotation processes used to obtain nickel, copper, iron and precious metals at the International Nickel Co. plant at Sudbury, Ontario.

Columbus Branch

The regular May meeting and annual banquet was held at the Jai Lai Cafe on Thursday, May 1, 1958. Forty-seven members and wives attended. President *Cal Smith* called the meeting to order and thanked the officers and members for their cooperation during the past year. He then introduced the speaker, *Bill Pepper* of WBNS-TV whose topic was "Bloopers on Radio and TV."

After a round of applause for the speaker, *Bill Neill* presented the newly elected officers for 1958-9. They are as follows: President, *Harry L. Moore;* 1st Vice President, *Marvin Pingel;* 2nd Vice President, *Rudolf A. Skriletz;* Secretary, *Halvor Christianson;* Treasurer, *Frank Gentile;* Librarian, *Leslie D. McGraw;* Board of Managers, *Nathan L. Koslin, William J. Neill, Calvin G. Smith.*

The newly installed president, *Harry Moore,* accepted the gavel from the outgoing president and adjourned the meeting.

Halvor S. Christianson
Secretary

Waterbury Branch

The May meeting was held at the Roger Smith Hotel on May 8. The secretary read the minutes of the previous business meeting and enumerated several changes in operating procedure which are to be tried in the next year in an effort to get greater participation in the business affairs of the branch.

The title of the evening's activities was "Old Timers Night" and there was a large turn out of old timers. Secretary *Al Griffith* read a list of twenty members who had been in the branch twenty or more years and a list of past presidents, many of whom were at the meeting. An "Old Timers" panel composed of *Leroy Miller, Clifford Prescott* and *Bert Sage* did justice to the topic, "Plating, Yesterday and Today." It was of particular interest to newcomers to the trade to learn of the early trials and tribulations in the development of processes which are now taken for granted. Early development of cleaning, brass plating, cadmium plating and chromium plating was discussed.

Following the meeting beer, potato chips and much conviviality were dispensed as the group stayed to reminisce.

The next meeting will be held in September.

F. A. Schneiders
Publicity Director

Los Angeles Branch

Jack B. Winters of Cleveland, O., president of Incar, Inc., headed the educational program of the meeting on the night of May 14 when he addressed 85 members and guests on "The Anode's Side of the Story." Mr. Winters was introduced by Librarian *Harvey K. Hunt* as one of the country's outstanding authorities on anodes.

President *Norman M. McEwan* presided at his first full meeting since election in March and demonstrated a thorough knowledge of A.E.S. constitutional regulations in the course of an impromptu discussion that arose concerning methods of revising the branch's present system of nominating candidates for office. He appointed a special committee to discuss the entire matter and report at the June meeting. Named to the committee were *Don Bedwell* (chairman), *Mrs. Vonna Ott, Leo Missel, Earl Coffin* and *Claude C. Weekly.*

Convention delegates *Truman Stoner, Earl Arnold* and *Emmett H. Babcock,* who were to leave the following day for Cincinnati, O., were uninstructed, giving them a free hand in voting at the Supreme Society conclave. *Earl Coffin* presided over a brief ceremony during which retiring president *George Magurean* was presented with the past-president's pin. *Carl*

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Troncal and *Lester Hunt* of Cadmium & Nickel Plating Co., *Lee Bjellant* of Convair, Inc., and *Barry Blackburn* of Oakite, Inc., were initiated. The application of *Robert Martin* of Alert Supply Co. was referred to the board of managers for processing.

N. A. C. E.

T. J. Hull assumed his new duties as executive secretary, National Association of Corrosion Engineers, April 1. *R. W. Huff, Jr.*, became assistant executive secretary. Mr. Hull had been assistant executive secretary for the year preceding. *A. B. Campbell*, formerly executive secretary, retired March 31.

Mr. Hull joined NACE in February, 1952. He was in charge of central office work with regions and sections for two years and then became technical secretary, a position involving the association's technical committees. During World War II he was in the U. S. Navy, with service totaling seven years. He attended the U. S. Naval Academy and holds a B. S. degree in mechanical engineering from the University of Houston.

Mr. Huff, prior to assuming his new post, had handled various administrative details of the association's activities, particularly in connection with annual conferences and exhibits, and with membership activities in regions and sections. He is a graduate of Texas A & M College with a B. S. in chemical engineering. He served in the Air Force during World War II.

FEDERATION OF PAINT & VARNISH PRODUCTION CLUBS

For the second year, technical papers entered in competition for the Roon Foundation Awards will be a program feature of the Annual Meeting of the Federation of Paint and Varnish Production Clubs, which will be held at the Cleveland Public Auditorium from October 5-9. All winning papers will receive additional recognition through publication in the *Official Digest*, technical journal of the Federation.

AMERICAN SOCIETY FOR ABRASIVES

The by-laws submitted by the Long Island members have been approved by the Board of Directors of the ASA and a charter has been granted designating them as Long Island Chapter No. 8.

Officers for the coming year of this newest chapter are: *Bert J. Kemper*, president; *Paul E. Frick*, vice-president; *Joseph Urgo*, treasurer; and *Herman Golden*, corresponding secretary. Inquiries concerning activities of the Long Island Chapter should be directed to Mr. Golden at 71 Lion Lane, Westbury, L. I., N. Y.

Immediate plans of the Long Island Chapter are to conduct an active membership drive in the area, to support the expanded program of the Society, and through planned Chapter activities to stimulate interest in and increase knowledge of the field of abrasives.

NATIONAL ASSN. OF CORROSION ENGINEERS

General aspects of corrosion, and specific corrosion problems, especially problems concerning Western U. S. Corrosion Engineers, will be considered at the Western Region Fall Meeting of the NACE. The meeting will be held in Los Angeles, California, at the Statler Hotel, November 17-19, 1958.

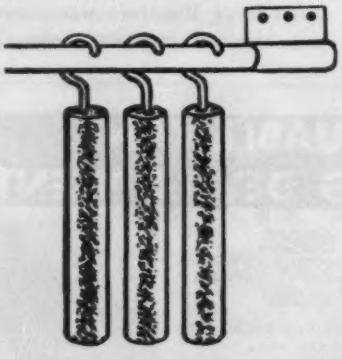
A "workshop" type short course on protection of underground structures and pipe lines will be held November 20-21, beginning the day after the end of the region meeting. It will include practical methods of surface preparation, paint and plastic coatings, pipe line coatings and wrappings, and cathodic protection. It will probably be held on the grounds of the Standard Oil Company of California, El Segundo, Calif.

OBITUARIES

FRANKLYN J. MacSTOKER

It is with deep regret that we announce the passing of Franklyn J. MacStoker, one of the best known and best loved members of the American Electroplaters' Society.

Mac, as he was known to his many friends, died recently at the age of 71 after a short illness. He had been in charge of finishing specifications and production finishing for the Farrand Optical Instrument Corp. for the past ten years. He had been actively engaged in the Branch and National Affairs of the AES for over 35 years, and



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was elected an Honorary Member of the Supreme Society and the New York Branch.

A delegate to conventions since 1928, Mac had been Branch vice president and president, secretary-treasurer, and was Supreme President of the AES in 1952. He was also Chairman of the Silver Jubilee Convention of the National Society held in New York City in 1937.

Survivors are his widow, Margaret; two sons, Robert and William; a daughter, Mary Vaeth; and two grandchildren.

LOUIS J. DONROE

Louis J. Donroe, a past president of the Newark Branch of the *American Electroplaters' Society*, died recently at the age of 52 after a sudden illness.

Mr. Donroe, who majored in chemical engineering at Pratt Institute, was general manager of Pyro Metal Finishers, Inc.

He is survived by his widow, *Frances Berger Donroe;* a son, *Frank W.* of Brooklyn; a daughter, *Regina*, at home; three brothers, *Albert, Joseph* and *William*, and two sisters, *Anna* and *Mrs. Rose Valentino*, all of New Haven.

CARL J. SOMMERS

Carl J. Sommers, president of *Sommers Bros. Mfg. Co.*, died in his 64th year, after a long illness.

Mr. Sommers was affiliated with the plating and polishing industry for over forty-five years, having started with Lasalco, Inc., of St. Louis, as a young man. After that he was associated with The Lustre Co. of St. Louis and, since April 1941, was president of Sommers Bros., a position he held until his death on May 5th, 1958.

WILLIAM HUNT EISEMAN

Nationally and internationally known among members of the metallurgical profession and in the metalworking industry, *William Hunt Eisenman*, 73, secretary and a founder-member of the *American Society for Metals*, died Friday, May 30 in a LaJolla, Calif., hospital. Mr. Eisenman, who served the ASM for 40 years and was managing director of the National Metal Exposition and Congress ("Metal Show"), succumbed following a heart attack at his Palm Springs, Calif., vacation home.

A native of Jamestown, Ohio, Mr. Eisenman joined the American Society for Steel Treating, forerunner of the ASM, in 1918 as national secretary. Under his leadership the society grew from a one-desk organization with fewer than 200 members to more than 30,000 members in 105 chapters in the U. S. and Canada.

The late ASM secretary was educated at Kenyon College, Stanford University, Morningside College, Iowa and Ohio State University. After a brief period as a professional football player with the old Olympic Club, he began his career as a high school principal in Olathe, Kansas, was head of the chemistry department at Racine (Wis.), College, and superintendent of schools in Elmhurst, Illinois.

Surviving are his widow, *Mildred Randle Eisenman*, and a brother, *Harley*, of Richmond, Va. A son, *Lt. William H., Jr.*, was killed in World War II.

Manufacturers' Literature

Spray Guns

The DeVilbiss Co., Dept. MF, Toledo 1, Ohio.

Covering manual or automatic spray guns for general or specialized service, this catalog, Form I-2000, is designed to tell the user how to select the proper gun for the job to be done and the material to be used, and then how to combine it with the proper nozzle to insure maximum efficiency and economy. It also includes valuable information on cleaning and lubricating spray guns.

All specifications and models for each spray gun are listed.

Ovens, Dryers, and Heaters

J. O. Ross Engineering Div., Midland-Ross Corp., Dept. MF, 444 Madison Ave., New York, N. Y.

A new eight-page, two-color booklet, pertaining to ovens, dryers and heaters, contains more than two dozen photographs, and includes information on indirect oil or gas fired heaters, a shell type direct air heater, a tubular type

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indirect air heater, and the Supertherm high pressure hot water heating system.

Temperature Chart

Dean Thermo-Panel Coil Div., Dean Products, Inc., Dept. MF, 616 Franklin Ave., Brooklyn 38, N. Y.

A new nomograph, size 8½ x 11", enables engineers to determine logarithmic mean temperature difference in heat transfer design.

Ultrasonic Cleaners

Narda Ultrasonics Corp., Dept. MF, 160 Herricks Rd., Mineola, L. I., N. Y.

Data Sheet No. 1500 includes photographs and technical information on Sonblaster 60 watt ultrasonic transducer Models NT-601 through NT-609 and the new five-gallon 200 watt transducerized tank, the NT-1505. Two types of submersible transducers and eight different process tanks are covered. Fourteen ultrasonic systems, using various combinations of the G-1501 generator, are described.

Of special interest is a list of 35 soils which can be removed by ultrasonic techniques. Also mentioned are a number of metal-finishing operations for which the equipment is adapted.

Automatic Spray Equipment

Eclipse Air Brush Co., Dept. MF, 390 Park Ave., Newark 7, N. J.

This eight-page booklet covers the spray painting of parts, sub-assemblies and complete products. It discusses various shapes and sizes which can be painted automatically.

Canned Motor Pumps

Chempump Corp., Dept. MF, 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Revised four-page bulletin 1050-3 details features and specifications of the company's line of pumps for general process pumping. Included are performance curves for pumps up to 15 horsepower, dimensions, principles of construction and operation, cutaway views, materials available, power requirements and other descriptive material.

Power Supplies

Perkin Engineering Corp., Dept. MF, 345 Kansas St., El Segundo, Calif.

A new catalog, No. E-58, illustrates and describes a complete line for DC power supplies, AC line regulators, and static inverters.

Alkaline Deruster

Pfanstiehl Laboratories, Inc., Dept. MF, 104 Lakeview Ave., Waukegan, Ill.

A new data sheet on Seqlene for alkaline derusting and descaling metals, gives proper solution strength per gallon and conditions for most effective use.

Plating and Conveyor Racks

Rack Processing Co., Dept. MF, Box 515, Far Hills Station, Dayton 9, Ohio.

A four-page, illustrated booklet is available on the above firm's machining and fabricating facilities for the design and manufacture of racks from "part to finish."

Roller Coaters

The Black Brothers Co., Inc., Dept. MF, Mendota, Ill.

The above firm has issued a twelve-page, illustrated booklet on its roller coaters. Advantages and outstanding features are given, as well as construction features, optional equipment; super series and bench type roller coaters.

Coatings and Processes

Metal & Thermit Corp., Dept. MF, Rahway, N. J.

A new 28-page brochure details many of the above company's products and activities.

Included in the illustrations are both photographs of installations and uses of the firm's products, and drawings of pertinent subjects and situations mentioned in the text.

Waste Treatment

Roy F. Weston, Inc., Dept. MF, 4 St. Albans Ave., Newton Square, Pa.

A new booklet describes laboratory and pilot plant facilities for the study of industrial water pollution, sewage treatment, water supply and air pollution problems.

Polyvinyl Plastisols

Chemical Products Corp., Dept. MF, King Philip Rd., E. Providence 14, R. I.

A 16-page brochure features new end-uses for Chem-o-sol coating and molding compounds and describes varied application methods. It includes technical data on stock formulations and descriptions of anticipated future uses. Case histories cite production cost-cutting techniques as well as product improvements.

Barrel Finishing Machinery

Baird Machine Co., Dept. MF, Stratford, Conn.

New machines detailed in a completely revised catalog-data book include "Poliaction" barrel finishing machines. Also listed and detailed are a wide range of both oblique tilting and horizontal machines ranging from bench models to the largest standard sizes, and including ball burnishing machines. Included are preliminary details on new developments in special

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multiple horizontal high-production barrel finishing machines.

Ultrasonic Cleaning

Branson Ultrasonics Corp., Dept. MF, 40 Brown House Rd., Stamford, Conn.

Twenty-four page Bulletin S-200, 8½ x 11 in. in size, explains practical applications and basic principles of this modern cleaning method, as well as design of equipment.

Design information occupies a large part of the booklet. Information on solutions and chemicals recommended for ultrasonic cleaning is also included.

Barrel Finishing Media

Esbec Barrel Finishing Corp., Dept. MF, 18 Beech St., Byram, Conn.

A new folder discusses all type of barrel finishing media, including aluminum oxide chips, triangles and spheres, natural chips, novaculite, granite, limestone, and steel media. It also gives detailed size specifications for each type.

Centrifugal Dust Precipitator

American Air Filter Co., Inc., Dept. MF, 215 Central Ave., Louisville 8 Ky.

A new bulletin describes the AAF Skimmer, a centrifugal dust precipitator. Bulletin 276 includes drawings and photographs which show the construction, dimensions, and different arrangements.

Flexible Deburring

Lea Mfg. Co., Dept. MF, 16 Cherry Ave., Waterbury 20, Conn.

A new 8-page technical bulletin describes flexible burring utilizing the manufacturer's compound and methods.

Spray Guns

The DeVilbiss Co., Dept. MF, Toledo 1, Ohio.

The above firm has issued a sixteen page, illustrated catalog, No. 1-2000, on its spray guns. Listed are manual, automatic, and special purpose guns, with specifications, models and a complete nozzle guide. A price list is also included.

Organic Chlorine Compounds

Union Carbide Chemicals Co., Dept. MF, 30 E. 42nd St., New York 17, N.Y.

Eleven organic chlorine compounds available in commercial quantities are described in a new 45-page booklet, which details physical and physiological properties, use information, shipping regulations, handling and storage, and specifications and test methods.

The materials discussed are ethylene dichloride, Chlorasol fumigant and solvent, propylene dichloride, trichlorethane, butyl chloride, 2-ethylhexyl chloride, dichlorethyl ether, dichlorisopropyl ether, triglycol dichloride, ethylene chlorhydrin, and epichlorhydrin.

Black Finish For Steel

MacDermid Inc., Dept. MF, Waterbury 20, Conn.

Blackmax, a single-dip process for blackening steel is fully described in a new three-page usage and instruction sheet. Also described in Technical Data Sheet No. 15 are several rust protective products giving good results with the process.

High Vacuum Valves

Vacuum Equip. Div., F. J. Stokes Corp., Dept. MF, 5500 Tabor Rd., Philadelphia 20, Pa.

Principal features of the Series ST gate type high vacuum valves are described in a new data sheet.

Conveyors

Conveyor Div., American MonoRail Co., Dept. MF, Fourth & Franklin Sts., Tipp City, Ohio.

A new 44-page Catalog CDA describes the "Cable-Way" overhead conveyor. The catalog contains 10 pages of installation photos. Also illustrated are all of the components of the system. Information in the catalog is complete enough to engineer a conveyor of any size.

Flexible Shaft Polishers

Wyzenbeek and Staff, Inc., Dept. MF, 223 N. California Ave., Chicago 12, Ill.

Catalog No. 58 includes not only a complete line of flexible shafts and flexible shaft machines, but also an expanded line of accessories. Along with the quick change angle heads and handpieces are shown a complete line of wire brushes, grinding wheels, mounted points and other tools for use with the machines.

Belt Conveyor Systems

E. W. Buschman Co., Dept. MF, 4468 Clifton Ave., Cincinnati 32, Ohio.

A fully illustrated 4-page bulletin has complete details on the new Series "L-M" horizontal and inclined belt conveyors.

Included in Catalog 80 are complete dimensional diagrams of typical cross sections for both inclined and horizontal applications.

Extension Spray Guns

Eclipse Air Brush Co., Dept. MF, 390 Park Ave., Newark 7, N. J.

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1—4000/2000 AMPERE, 12/24 VOLT, 25°C. **CHANDEYSSON,** Synch.
1—4000/2000 AMPERE, 6/12 VOLT. **H-VM-M,** Synch., Exc.-in-head.
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4 Industrial Filter Units; Model RDR2 Rubber lined with slurry tanks for nickel solution; 2000 gal. per hr. motor AC 3 ph. size 18x48 complete.

6 Semi-Automatic Plating Tank Units: Udylite 20' — HVWM 20' — Crown 35' — U. S. Galvanizing 12', 16' and 20'.

1 HVWM 4 station Plating Barrel Unit: 36x14; rubber lined tank, rubber cylinders.

4—Industrial RDR2 rubber lined filters & slurry tanks. 4500 gal. per hr. Sizes 36-36-30 with AC 3 ph. motor complete.

3 Blakeslee Niagara Single Stage Motor Driven conveyor washers 8' long with 18" wide belt.

10-Mears Kane Ofeldt gas fired steam tubular boilers. 2-20 HP with pump units.

10 Centrifugal Dryers: acid crocks, motor driven exhaust fans, fume blowers, complete acid and dip rooms, cleaning and washing tanks, plating racks and many other items.

30 Rubber lined Nickel Plating Tanks: 2' to 12' long; with rods, rheostats, motor driven tank rod agitators, heating coils, etc.

16 DETREX, BLAKESLEE, CIRCO, Steam, Gas and Electrically Heated Degreasers: 3' to 6' long, single dip and 3 dip type, with pumps, tanks, fume ducts.

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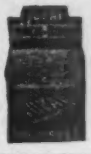

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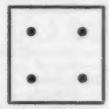

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2—Udylite	1500	Amperes	24 volts
1—Udylite	1500	Amperes	48 volts
1—Rapid	2000	Amperes	6 volts
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1—Chandeysson	3000	Amperes	12 volts
1—Udylite	3000	Amperes	24 volts
2—Rapid	6000	Amperes	6 volts
1—Udylite	6000	Amperes	12 volts
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Dow Chemical Co., The 8, 9
Midland, Mich.
Du Pont de Nemours & Co., E. I.
Wilmington 98, Del.
Egyptian Lacquer Mfg. Co.
Box 444, Newark 1, N. J.
Electro-Glo Co.
1430 So. Talman Ave., Chicago 8, Ill.
Electrochemical Products Co. 108
2800 W. Glendale Ave., Milwaukee 9, Wis.
Electronic Rectifiers, Inc. 98
2102 Spann Ave., Indianapolis 3, Ind.
Enthone, Inc. 3
442 Elm St., New Haven, Conn.
Federated Metals Div., American Smelting & Refining Co. 25
120 Broadway, New York 5, N. Y.
Formax Mfg. Corp. 100
3171 Bellevue, Detroit 7, Mich.
G. S. Equipment Co.
15585 Brookpark Rd., Cleveland 10, Ohio
Gerson Co., Louis M.
Box 175-F, Mattapan, Mass.
Glo-Quartz Electric Heater Co., Inc. 95
Willoughby, Ohio
Grover Water Conditioning Co.
216 W. 14th St., New York 11, N. Y.
Guaranteed Buff Co., Inc.
20 Vandam St., New York 13, N. Y.
Gumm Chemical Co., Inc., Frederick Inside Front Cover
538-542 Forest St., Kearny, N. J.
Hamilton Emery & Corundum Co. 109
Chester, Mass.
Hammond Machinery Builders, Inc.
1601 Douglas Ave., Kalamazoo 54, Mich.
Hammond Solvents Recovery Service 112
241 Brunswick St., Hammond, Ind.
Hampshire Chemical Corp. 31
Poisson Ave., Nashua, N. H.
Handy & Harman
82 Fulton St., New York 38, N. Y.
Hanson-Van Winkle-Munning Co. 82A-D
Matawan, N. J.
Harrison & Co., Inc.
487 Groveland St., Haverhill, Mass.
Harshaw Chemical Co., The 17
1945 E. 97th St., Cleveland 6, Ohio
Heatbath Corp. 21
Springfield 1, Mass.
Heil Process Equipment Corp. 34
12901 Elmwood Ave., Cleveland 11, Ohio
Henderson Bros. Co. 90
136 S. Leonard St., Waterbury, Conn.
Holland & Sons, Inc., J. 110
485 Keap St., Brooklyn 11, N. Y.
Hooker Chemical Corp.
1303 Union St., Niagara Falls, N. Y.
Hull & Co., Inc., R. O.
1300 Parsons Ct., Rocky River 16, Ohio
Ideal Chemical Co. 111
1499 Dean Dr., So. Euclid 21, Ohio
Illinois Water Treatment Co.
840 Cedar St., Rockford, Ill.
Industrial Filter & Pump Mfg. Co. 22
5906 Ogden Ave., Chicago 50, Ill.
Industrial Instruments, Inc.
89 Commerce Rd., Cedar Grove, N. J.
Ionic Electrostatic Corp.
105-119 Monroe St., Garfield, N. J.
Jelco Finishing Equipment Corp.
153 E. 26th St., New York 10, N. Y.
Kocour Company 98
4802 S. St. Louis Ave., Chicago 32, Ill.
Kohler Instrument Co., Inc.
168-56 Douglas Ave., Jamaica 33, N. Y.
Kosmos Electro-Finishing Research, Inc.
140 Liberty St., Hackensack, N. J.
Kramer Co., H. W.
120-30 Jamaica Ave., Richmond Hill 18, N. Y.
Kushner, Dr. Joseph B. 109
Stroudsburg, Pa.
Lasalco, Inc. 29
2820-38 Lasalle St., St. Louis 4, Mo.
Lea Mfg. Co. 34A
16 Cherry Ave., Waterbury 20, Conn.
Lea Michigan, Inc. 101
14066 Stansbury Ave., Detroit 27, Mich.
Lea-Ronal, Inc. 34B
139-20 109th Ave., Jamaica 35, N. Y.
Leiman Bros., Inc.
105 Christie St., Newark 5, N. J.
Lewis Welding & Engineering Corp.
106 Northfield Rd., Bedford, Ohio
L'Hommedieu & Sons Co., Chas. F. 5
4521 Ogden Ave., Chicago, Ill.
Lindale Equipment & Supply Corp. 110
504 Smith St., Brooklyn 31, N. Y.
Macarr, Inc. 100
2543 Boston Rd., Bronx 67, N. Y.
MacDermid, Inc. Back Cover
Waterbury 20, Conn.
Magnuson Products, Inc.
50 Court St., Brooklyn 1, N. Y.
Manhattan Rubber Div., Raybestos-Manhattan, Inc.
6 Willett St., Passaic, N. J.
Mearl Corp., The
124 E. 40th St., New York 16, N. Y.
Metal & Thermit Corp. 35, 42
Rahway, N. J.
Michigan Chrome & Chemical Co.
8615 Grinnell Ave., Detroit 13, Mich.
Miller Corp., Harry
4th & Bristol Sts., Philadelphia 40, Pa.
Mitchell-Bradford Chemical Co.
Wampus Lane, Milford, Conn.
Motor Repair & Mfg. Co., The 111
1555 Hamilton Ave., Cleveland 14, Ohio
Murray-Way Corp. 85
P. O. Box 180, Maple Rd. E., Birmingham, Mich.
Narda Ultrasonics Corp., The
160 Herricks Rd., Mineola, L. I., N. Y.
National Polymer Products, Inc.
Reading, Pa.
Nazar Rubber Co., The 108
2727 Avondale, Toledo 7, Ohio
New Holland Machine Co.
New Holland, Pa.
Northwest Chemical Co.
9310 Roselawn Ave., Detroit 4, Mich.
Norton Co.
1 New Bond St., Worcester 6, Mass.
Oakite Products, Inc. 4
18 Rector St., New York 6, N. Y.
Packer Machine Co. 94
456 Center St., Meriden, Conn.
Park Chemical Co.
8074 Military Ave., Detroit 4, Mich.
Pennsalt Chemicals Corp.
3 Penn Center Plaza, Philadelphia 2, Pa.
Pesco Plating Equipment Corp. 111
75 Wythe Ave., Brooklyn 11, N. Y.
Pfizer & Co., Inc., Chas.
630 Flushing Ave., Brooklyn 6, N. Y.
Phelps Dodge Refining Corp.
300 Park Ave., New York 22, N. Y.
Plating Products, Inc. 97
1509 N. Washington, Kokomo, Ind.
Potter Paint Co., Inc.
21 Crawford St., Cortland, N. Y.
Promat Div., Poor & Co.
851 S. Market St., Waukegan, Ill.
Quartz Radiation Corp.
54 Summer Ave., Newark, N. J.
Ramco Equipment Corp.
807 Edgewater Rd., New York 39, N. Y.
Randolph Products Co.
92 N. 12th St., Carlstadt, N. J.
Rapid Electric Co. 7
2881 Middletown Rd., Bronx 61, N. Y.
Raybestos-Manhattan, Inc. Manhattan Rubber Div.
Passaic, N. J.
Reynolds Chemical Products Co.
1200 N. Main St., Ann Arbor, Mich.
Robertshaw Fulton Controls Co., Fulton Sylphon Div.
Knoxville 1, Tenn.
Rona Laboratories, Inc.
E. 21st & E. 22nd Sts., Bayonne 3, N. J.
Sabin Metal Corp. 106
310 Meserole St., Brooklyn 6, N. Y.
Sandox, Inc.
61 Van Dam St., New York 13, N. Y.
Saran Lined Pipe Co. 28
2415 Burdette Ave., Ferndale 20, Mich.
Schori Process Div., FerroCo Corp.
8-11 43rd Rd., Long Island City, N. Y.
Sel-Rex Corp. Inside Back Cover
75 River Rd., Nutley 10, N. J.
Service Screw Products Co.
131 N. Green St., Chicago 7, Ill.
Sethco Mfg. Co. 99
2286 Babylon Turnpike, Merrick, L. I., N. Y.
Siefen Co., J. J. 96
5643 Lauderdale, Detroit 9, Mich.
Simonds Abrasive Co.
Tacony & Fraley Sts., Philadelphia 37, Pa.
Solbern Mfg. Corp.
120 13th St., Brooklyn 15, N. Y.
Solvay Process Div., Allied Chemical Corp. 23, 33
61 Broadway, New York 6, N. Y.
Solvents Recovery Service
1025 Broad St., Newark 2, N. J.
Sommers Bros. Mfg. Co. 109
3439 No. Broadway, St. Louis 7, Mo.
Spee Flo Mfg. Corp.
6614 Harrisburg, Houston 11, Texas
Stevens, Inc., Frederic B. 20
1808 - 18th St., Detroit 16, Mich.
Stokes Corp., F. J. 87
5500 Tabor Rd., Philadelphia 20, Pa.
Storts Welding Co., Inc. 96
38 Stone St., Meriden, Conn.
Stutz Co., The
4430 W. Carroll Ave., Chicago 24, Ill.
Surety Rubber Co.
Carrollton, Ohio
Syntron Co.
Homer City, Pa.
Technic, Inc. 41
39 Snow St., Providence, R. I.
Timesavers, Inc.
Box 7446, Robinsdale Station, Minneapolis 22, Minn.
Tramer Co., The Gilbert 24
1217 Main Ave., Cleveland 13, Ohio
Tranter Mfg., Inc. 10
Lansing 9, Mich.
Trerice Co., The H. O.
1424 W. Lafayette Blvd., Detroit 16, Mich.
True Brite Chemical Products Co. 97
P. O. Box 31, Oakville, Conn.
Udylite Corp., The 11, 18, 19
Detroit 11, Mich.
Unit Process Assemblies, Inc. 103
61 East 4th St., New York 3, N. Y.
U. S. Galvanizing & Plating Equipment Corp. 40
31 Heyward St., Brooklyn 11, N. Y.
U. S. Stoneware
Akron 9, Ohio
Univertical Foundry & Machine Co. 34
14841 Meyers Rd., Detroit 27, Mich.
Victor Chemical Works
155 No. Wacker Dr., Chicago 6, Ill.
Wagner Brothers, Inc.
418 Midland, Detroit 3, Mich.
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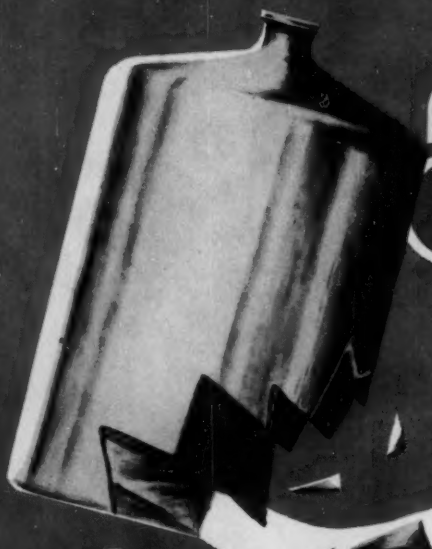

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